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ILLINOIS TECHNOGRAPH

PREVIEW OF YOUR ENGINEERING FUTURE

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MARCH, 1955 **.25**

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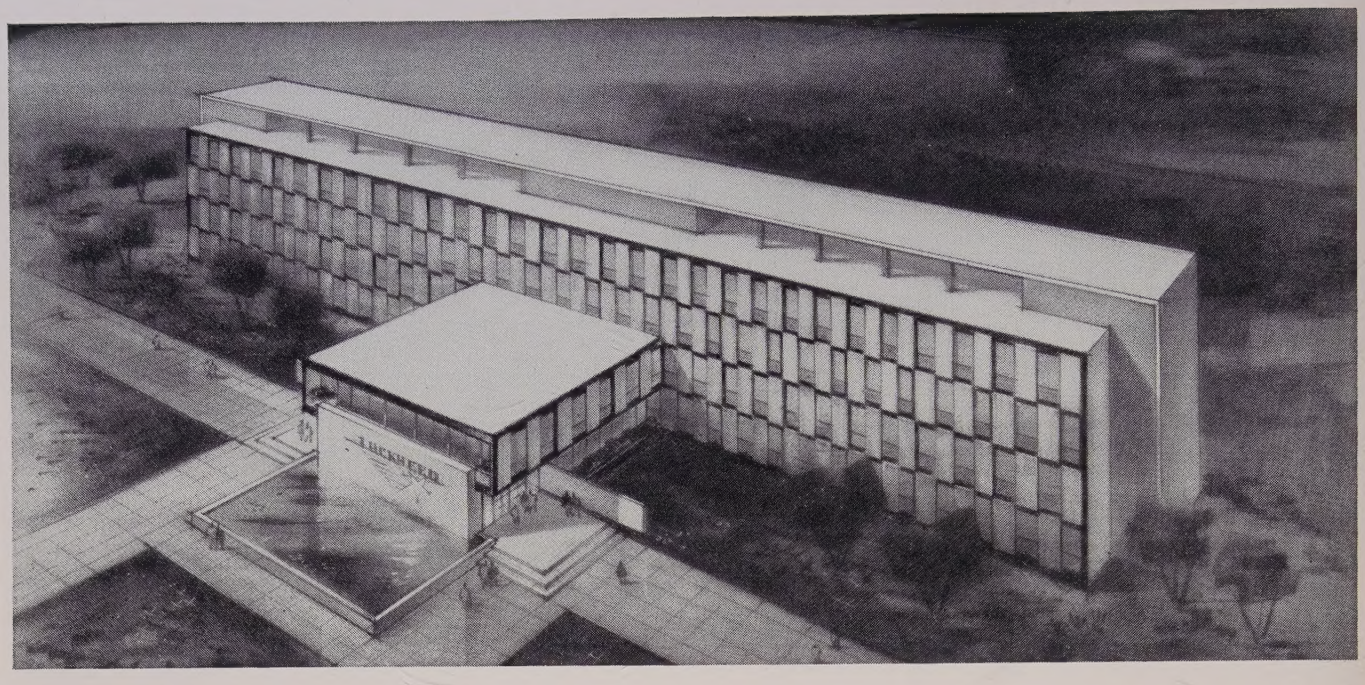

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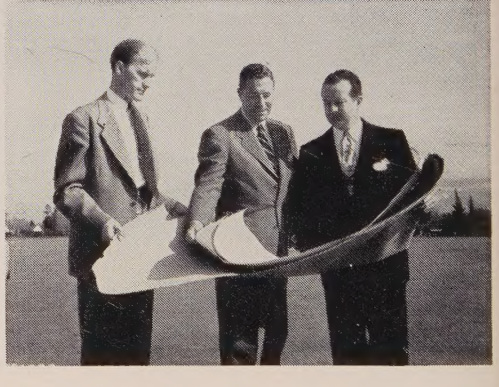

Dr. E. H. Krause, Research Laboratory head (left), examines blueprints of the new laboratory with E. R. Quesada, Missile Systems Division vice president and general manager (center), and W. M. Hawkins, chief engineer, during ground-breaking ceremonies.

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Marketing is another good field that will help an engineer. As an engineer, you will know something of the kind of consumer your product must satisfy. You must know his tastes, quantitative needs and budget. Only then can you best satisfy your customer.

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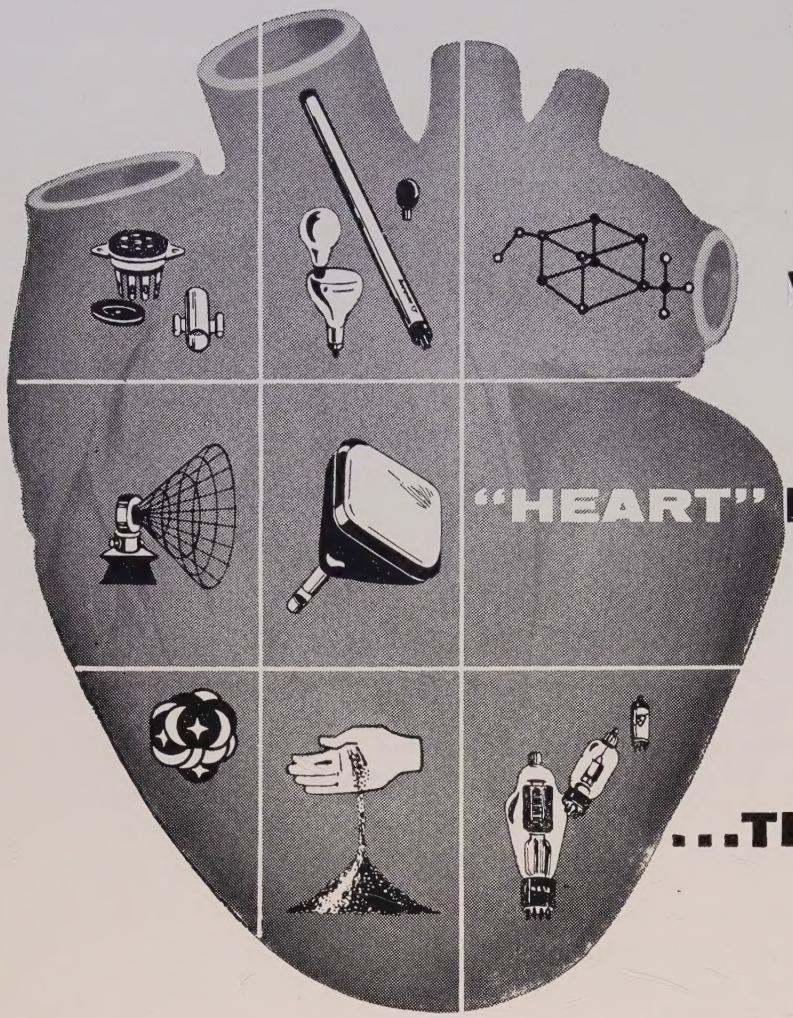
Psychology, history, and literature courses are far from waste if you expect to take part in conversation with anyone. Employers, consciously or otherwise, look for an employee that is well versed in happenings and has a good vocabulary.

Take an intelligent look at courses offered as non-technical electives and get something out of the work you put into them.

D. F. K.



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THE ILLINOIS TECHNOGRAPH

volume 70 **number 6**

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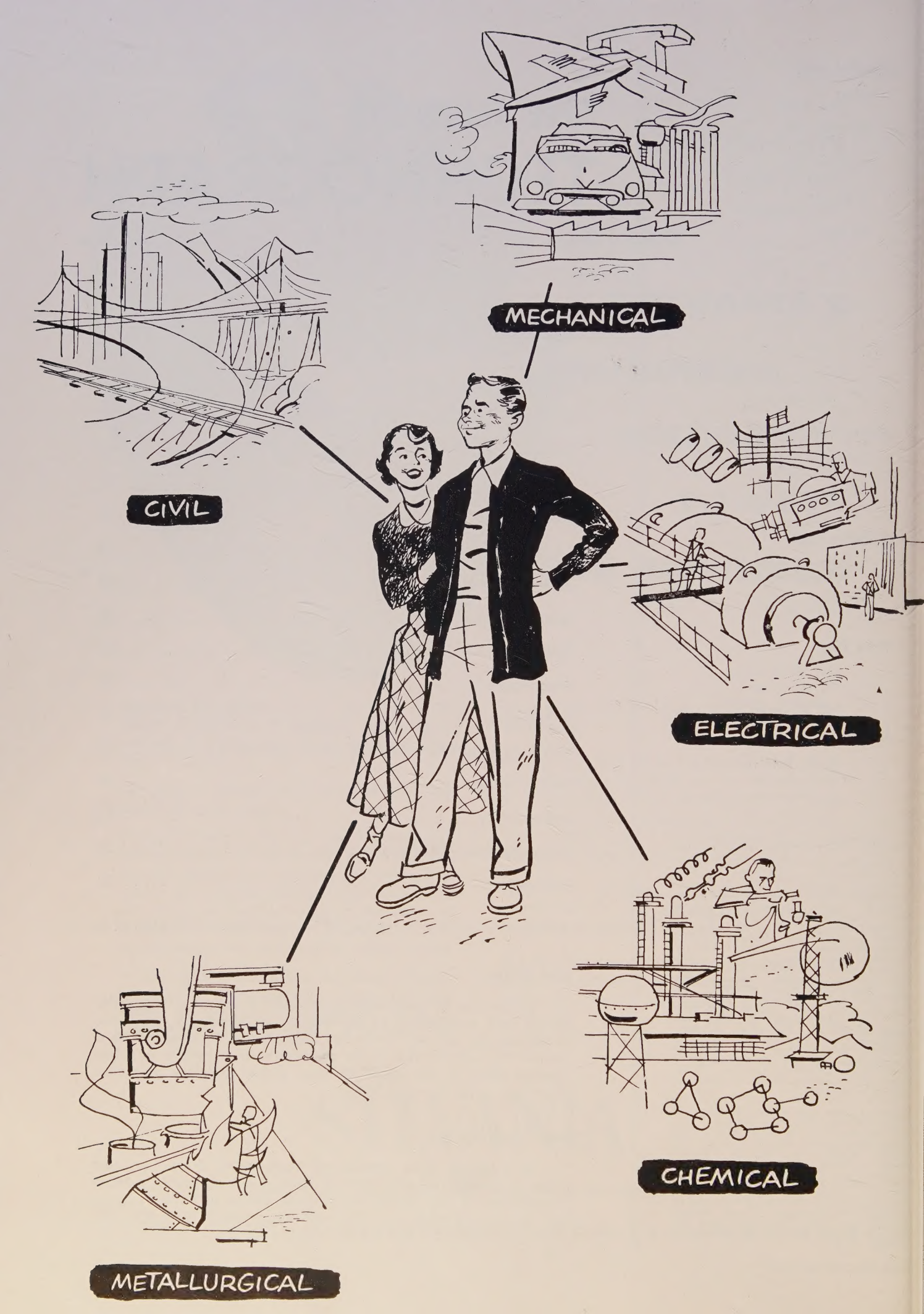
our cover

A preview of your engineering future would envision the design and supervision of construction of numerous structures, machines and devices, some yet unheard of. Engineering as a science has utilized the forces and material of nature and has applied them to the needs of man. (Cover courtesy of Kaiser Alumnium and Chemical Sales)

our frontispiece

In each of these phases of engineering there lies vast fields of unexplored phenomenon. Any of which should present a challenge to you. While the ultimate choice of fields is up to you, it may be helpful to talk over the problem with your advisor. (Drawing courtesy General Motors Corp.)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The Engineering Open House

by Keith A. Yarborough, San. E. '55

Perhaps it is a bit hackneyed to start n article with a question—but to ask What is the Engineering Open Iouse?" is to ask many questions. Since 920 the doors of the Engineering Cam- us at the University of Illinois have een thrown open to visitors from all ver the state. People from industry, ob- ervers from other universities, high chool students and teachers, and hosts f others who perhaps have no direct re- ationship with engineering but just like o learn "what makes the wheels go round" have attended these exhibitions. Yet to say that the Open House is sim- ly an exhibition is to do a great in- ustice to those faculty and students hose year-round efforts have made the vent so successful. A glance at the rec- rd shows that it is much more than an xhibition.

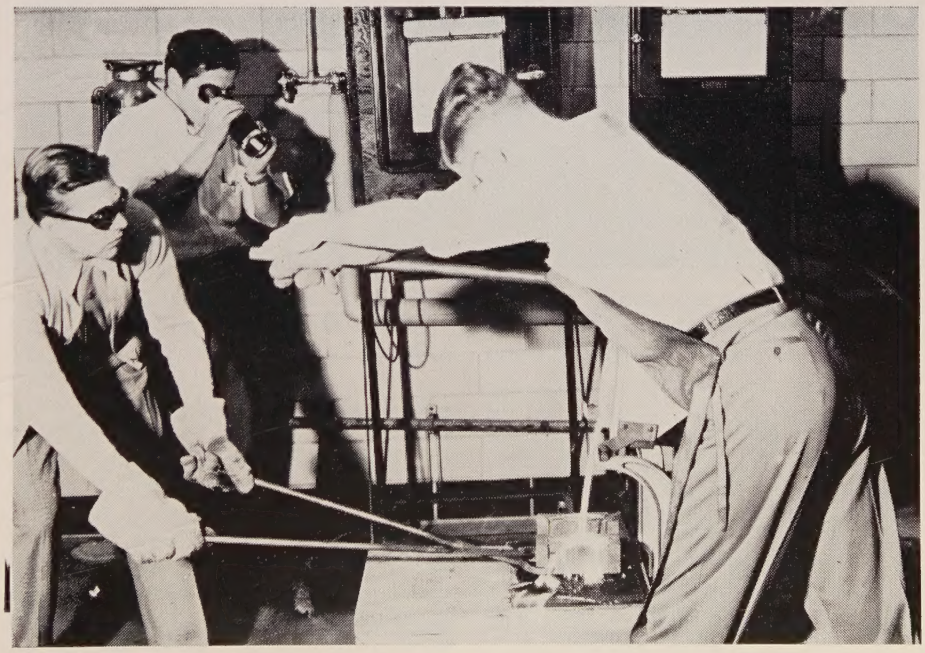
The Open House is the result of some 5 years of evolution. Beginning in the arly years of the century, it became the olicy of various departments to spon- or "shows" and "open houses" at which mes the students and faculty collabor- ted in demonstrations and lectures. Thus, in 1906 when the Department of Physics held its first annual Open Iouse, the precedent and inspiration for he present-day Engineering Open Iouse was established. This 1906 show- ng of departmental equipment was held the laboratories of Engineering Hall, here Physics was then located. The ex- ibits consisted of displays of apparatus the fields of light, sound, wireless legraphy, and other electrical opera- ons, accompanied by lectures on the rinciples involved. These basic physical oncepts have been enlarged upon so hat demonstrations of many principles ppear today which were relatively un- nown in 1906, including those on mod- rn electronics as well as atomic and uclear physics.

The next spring, in 1907, the Depart- ent of Electrical Engineering organ- ed the Electrical Engineering Show. The purpose was to raise funds in order to contribute to the construction of a memorial in honor of steamboat builder Robert Fulton which was to be erected in New York City. The show was a modest affair which required only a week's preparation at virtually no expense and for which a small admission fee was charged. The results took the originators by surprise, as the 1600 who attended enabled $250 to be donated to the memorial fund.

Encouraged by this success, the originators held subsequent shows, each a little more elaborate than the preceding. The proceeds were at first used to improve the furnishings of the Electrical Engineering Society reading room in the E. E. Laboratory. By 1913 the attendance had grown to about 3600, a capacity crowd which taxed the facilities of that lab to its limit.

In 1915 an important precedent of dual significance was established by the use of commercial exhibits donated by outside companies as a distinct feature of the Show. Because this addition required much additional space for equipment, the show was extended over three days and several buildings were used besides the E. E. Lab. Subsequent shows up to 1922 followed this same plan. By this time the show had become so enlarged that 450 student workers and demonstrators operating on a $4,000 budget were required. The show continued to be successful and to return a profit, which was being used to aid the Technograph and other University interests.

In 1924 such national recognition had been gained that commercial organizations and utility companies were eager to exhibit their products. Thus, the



M.E. students are pouring hot metal for sand castings. Samples are given away at the Open House with the demonstrations.

Shows from 1924 until the war necessitated termination of the event in 1942 were able to present many unusual and spectacular demonstrations. Among these, some worthy of note were automatic dial telephone systems, model hydroelectric plants and power transmission lines, radio broadcasting and receiving equipment, television, talking movies, and a list of others too long to enumerate. The proceeds of these Shows were placed in an E. E. student loan fund which is still in existence.

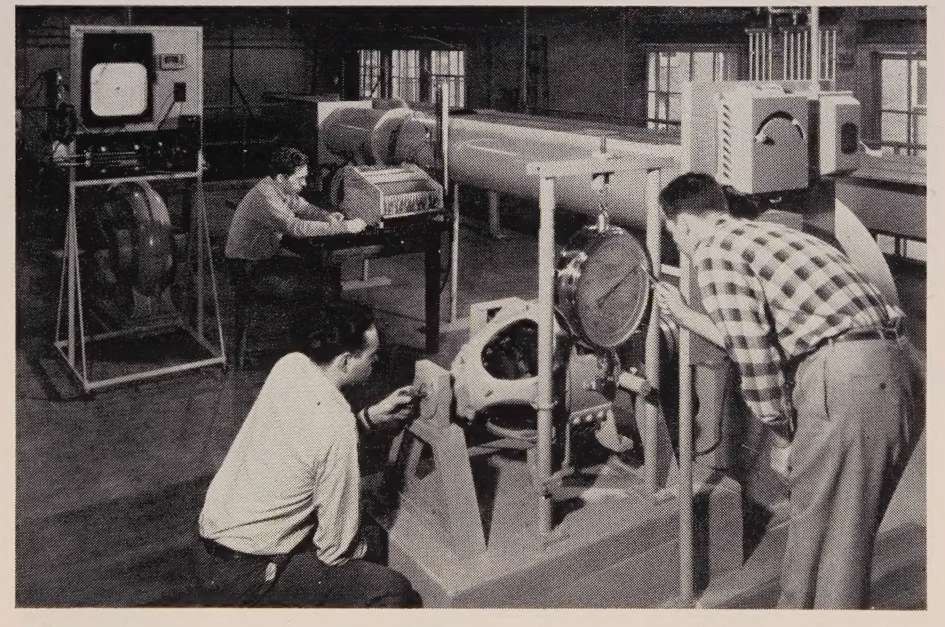
Also worthy of mention is the interest which the Shows had created among the people of the entire state. Started on a campus-wide scale, by 1936 and 1938 they were attracting crowds that ranged from 4000 to 6000 people, who came to the Show in everything from private cars and school or chartered buses to trucks. A large percentage of the guests were high school students and teachers, a fact which enabled the Show's directors to obtain reduced rates on the Illinois Central and Big Four railroads in 1936. Such groups were also assigned student guides who conducted them on tours of the University's campus before taking them through the Show.

In the later years, from 1938 to 1942, the tendency was to demonstrate more of the University's equipment and student work and thus to diminish the commercial flavor. In so doing, students devised many interesting exhibits. Most had a serious purpose, seeking to illustrate some of the latest advances in electrical engineering (though a few were purely for a showmanship purpose).

In the fall of 1914, a few years after the first E. E. Show, members of the Student Branch of the American Society of Mechanical Engineers acted as hosts at the first annual Mechanical Engineering Open House. Some 2000 people representing all departments of the University passed through the displays of student work and demonstrations of machines in operation, and heard talks on subjects concerning the popular mechanics of the day.

Exhibitions held in the following years proved to be even more successful. The attendance reached nearly 5000 persons by the fourth and last M. E. Open House, held in the spring of 1919. During these events, the practice of distributing ashtrays, paper weights and other small mementos as well as the showing of movies had been adopted. Last year nearly 20,000 people viewed displays demonstrating subjects ranging from arc welding to fluid flow studies. Here again, the fundamental engineering principles have been expanded, and reapplied by some 35 graduating mechanical engineering classes, to give spectators a view of the latest model automobile and punch press.

Inspired by the success which these several shows had enjoyed, the first regular all-engineering Open House was held in the spring of 1920, commemorating the centenary of the birth of James Watt. The Physics and M. E. Open Houses were discontinued at this time to give greater chance for success to the all-college venture. The public was invited to inspect the facilities of the Engineering College and to see the displays which had been set up in the laboratories, drafting rooms, and shops. The first Open House Program appeared at this time in the form of a 20-page pamphlet. It briefly described sixty-odd exhibits and contained a map of the engineering campus with a suggested itinerary. This general form has been maintained and is essentially the same layout used today.



Horsepower tests are made in the internal combustion laboratory. Dodge V-8, Chevrolet, G. M. C., and other engines are tested for horsepower output, fuel economy and other things.

Other Open Houses, later called Illinois Student Engineering Exhibitions, were held throughout the years. Students in all departments participated and were guided in their efforts by the Engineering Council. In 1928, the Open House was so scheduled as not to conflict (in year) with the E. E. Shows. Also, the policy was adopted of inviting groups from the high schools of the state, interested persons from out-of-state or other nearby colleges, and other such groups.

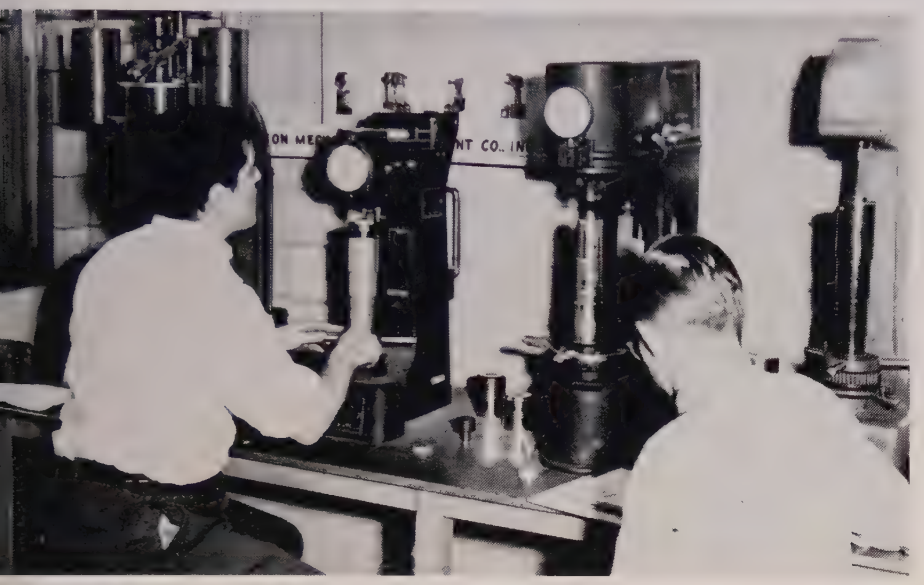
As was true of the E. E. Show, the all-engineering show was dicontinued during the war years. During the immediate post-war period the E. E. Show was reorganized and became a definite part of the newly named Engineering Open House. Starting in 1948 and carrying through 1952, the Open House was held biennially. However, following the 1950 show, it was suggested that the Open House be planned as an annual affair. This proposal was accepted by both the Engineering Council and the Executive Committee of the College of Engineering as an experiment in 1952 and 1953. Hence, the 1955 Open House represents the fourth time that the annual event has been successfully planned. It is therefore well beyond the experimental stage.

Since its beginning in the departmental exhibition, the Engineering Open House has never been planned or executed as a "stunt show" (though some of its exhibits are indeed quite amazing and spectacular). One major purpose has always been to give benefit to the students participating, and it is therefore primarily educational. The long standing goal has been to better acquaint the students and faculty of the College of Engineering and of the other colleges on the campus, as well as the public in general, with the facilities and work of the college. The exhibits are intended to readily demonstrate to the public some of the fundamental principles upon which the science of engineering is based and to point out how the student is equipped to utilize these principles during and after his course of study.

Following the lead of the E. E. Show, outside exhibits such as those from commercial organizations are sought only when they demonstrate the desired concepts more clearly than can student-prepared displays. Never has admission been charged to finance any of the Open House exhibitions.

During the discussion of the evolution of the Engineering Open House,

eference was made to the progress in ne science of engineering which can e traced by the student exhibits held ver the years. This is another import-nt objective which the Open House eeks to realize. Thus, the Engineering)pen House is valuable as a means of iding progress. The exhibits and dem-nstrations each year attract people from hree general groups. The largest group



Rockwell hardness testers measure the hardness of materials without damaging it. The test leaves a small indentation in the specimen.

onsists of those who have a general in-erest as citizens of the State. The sec-nd group consists of those who are in-erested in the Engineering College as center of research and training for uture engineers—i.e., industry. The hird group is composed mainly of high chool students who have scientific in-erests and wish to learn whether en-ineering should become their life's ork. The Open House attempts to nswer the questions of these groups by nnually placing the entire facilities of ne College on display.

To the general observer this is im-ressive and imparts the feeling that he, s a citizen and taxpayer of the State, as had a hand in making this center of echnical education and reserch possible. The industrial person sees students, the ngineers of the future, organizing and onducting a large-scale enterprise. He bserves that the men involved have had take into consideration practically all the factors involved in any industrial nd engineering project. Realization of ese factors requires organizational ilities and gives the students many op-rtunities to test their judgment and genuity.

First of all, the proper setup of stu-ent officers who will be in charge must e established. This selection of student aders requires careful consideration as to the kinds of ability needed in each office that is to be filled, as well as an analysis of the abilities of the men who are eligible to fill these offices. Such a project also requires that thought be given to financial and business matters and to the problems of setting up the proper machinery for operation. In addition the exhibits must be selected on the basis of their educational value and public appeal. Advertising and publicity, in the form of printed programs, radio and TV shows, automobile stickers, newspaper articles, speeches and posters, must be carried out. Thus the Open House is an undertaking requiring the time and efforts of many students working together toward a common goal.

All of these things are readily observable to those who care to look "behind the scenes." Here another great educational value is again observed—the fact that some men discover and perfect abilities of leadership which will serve them well in later work whereas others, though lacking in leadership perhaps, find that they are qualified to handle practical problems as these are encountered. Perhaps most important is the invaluable experience which teamwork provides and the sense of comradeship which it instills in all.

Thus the third interested viewer, the high school student, soon realizes that this is indeed a student enterprise. In the various exhibits he not only sees *what* the practicing engineer does in any particular field but he is made aware of *how* the student engineer is trained to think and act in such situations. Proof of the value of such training is furnished by the show itself. Indeed, no one man could conceive of and execute the many duties and tasks required for a successful Open House; but a group of men, using what they have learned to attack new problems, can achieve this goal. This is that part of the engineering education which is learned not so much in the classroom as outside it in the meeting rooms and around the conference tables.

And what about this? Indeed, answering this "what" will aid in telling what the Open House is. The students and faculty have plans for this year which are designed to demonstrate to everyone the potential for teaching and research that the College of Engineering of the University of Illinois possesses. The exhibits will be so arranged and talks on them so presented as to best point out what the engineering student is taught in his study program and how this training is directly applicable to the problems encountered "in the field." In so doing the exhibits themselves will be selected and utilized in such ways as to demonstrate the fact that they are not primarily teaching devices upon which examination questions are based but are functional units designed, built, and applied to satisfy specific needs and fulfill definite purposes. Every attempt will be made to answer questions not only on *how* they work but also *why*. Also, this year, particular emphasis is being placed on the values of the engineering profession in modern society and how young men are prepared to meet the challenging problems of the science by study here at the University.

As to the actual exhibits—they are too numerous to name (requiring some 20 pages of Program each year to describe). While some groups are running miniature ram-jet engines, others will be distilling alcohol and still others will be breaking concrete cylinders. One organization even hopes to furnish thirsty visitors with glasses of purified Boneyard water. Yet all these displays will be showing the same thing, basically; that the fundamental principles of engineering are being applied daily in solving the problems which enable us to be a *progressive* society.

We've talked a good deal about the Open House—its history, its purposes and its achievements. It should be apparent that the "what" of the Engineering Open House is not easily answered, for the real answer lies in the work which the participating students carry on. The success of the venture lies with them and challenges their ingenuity and "stick-to-it-iveness." What is considered and applied here is no different from the planning and execution of any engineering undertaking. Thus, when all the problems have been surmounted and the visitors arrive on March 11, 1955, the Engineering Open House again serves as a symbol of the promise and attainment of the engineering profession.

SANITARY ENGINEERING

by Frank L. Flood

It will be the purpose of this paper to concentrate on what the young sanitary engineer should learn through college training and during the first few years thereafter.

First, I would like to summarize certain general beliefs with which I am in accord.

1. The sanitary engineer must be thoroughly grounded in the fundamental principles of the natural sciences: mathematics, physics, chemistry, geology, and biology.

2. The arrangement of courses in these subjects should be in accordance with the scope of the problems which generally arise in the practice of sanitary engineering.

3. The elements of mechanics, structural design, materials of construction, hydraulics, design of waterworks and sewage works, principles of public health and sanitation and elements of electrical and mechanical engineering should be among the subjects studied.

4. The young engineer should be able to handle surveying instruments with reasonable skill, keep notes in the field, and plot the work in the office.

5. He should be able to draw reasonably well and needs to have an appreciation of the value of well-made plans and the value of clear graphical presentation of the facts by the use of plans, charts, and diagrams. The technical graduate should realize that drafting is not too menial a task for him to perform.

6. He should be able to perform the routine sanitary analyses of water and sewage.

7. The sanitary engineer needs to have a reasonably broad cultural background and to this end subjects such as English, history, and literature should be included in his education.

8. Some degree of training in the principles of economics and in business and public health law should be acquired.

9. A young engineer should learn the need for economy in the engineering expense put into the study and solution of a problem. He should have judgment as to the reasonable amount of time needed to perform a task.

10. The technical training should give a man sufficient instruction in report writing to enable him to recognize the facts to be set forth and their relative importance and should train him to present facts clearly and in logical arrangement.

11. The young engineer should become informed of the ordinary political practices and the normal operations of municipal, state and federal agencies, particularly as they affect public sanitary engineering works. Service in an appointive or elective capacity, particularly in municipal government, is of considerable value in learning to deal with municipal authorities in public works matters.

For the most part, the above conclusions relate to education up to the stage of postgraduate work. Some elaboration as to the training of the graduate engineer may be of value. While sanitary engineering covers a broad field of engineering relating to the betterment and control of environmental factors affecting the public health, the more specific work of the sanitary engineer in a private engineering organization offers sufficient scope for this discussion.

The engineering work of an organization such as the one of which I am a partner has to do primarily with investigations and reports, plans and specifications, supervision of construction, and operation of waterworks, sewage works, industrial waste disposal, drainage, garbage, and refuse disposal. Each individual project is administered by a partner with a project engineer in responsible charge. Usually the project engineer is a professional sanitary engineer.

For investigations and reports, the field work may involve surveys, gaging, sampling, testing, and design and operation of pilot plants. The field men may include rodmen, transitmen, party chiefs, assistant engineers and chemists. The reports are compiled by the project engineer with the help of assistant engineers. The young sanitary engineer should be capable of handling the job of party chief, assistant engineer, or chemist, the latter operating under the supervision of a chief chemist.

The preparations of plans and specifications on a project proceed under the direction of the project engineer. Functional drawings are made by the engineers and assistant engineers who are normally young sanitary engineers. Most modern sanitary engineering works are so complex that the design then proceeds through office departments which include structural, architectural, mechanical, and electrical. Each department is headed by a senior engineer or architect and includes the designers, detailers, draftsmen, and tracers. No one in these categories needs to be a sanitary engineer, but drafting ability will be helpful to a young sanitary engineer both in securing a job and to retain steady employment.

A detailed quantity estimate is usually required as a basis for estimates of cost and the young sanitary engineer can be useful and at the same time learn much about the functional details of the design while on such work.

Specifications and contract documents are normally prepared by the specifications engineer assisted by the senior engineers and project engineers. The young sanitary engineer must learn requirements for preparation of specifications and contract documents and usually learns by assisting either the project or the specifications engineer.

In the construction of a project, the professional sanitary engineer may furnish field parties to supply lines and grades, inspectors and resident engineers. It is very worthwhile for a graduate sanitary engineer to spend some time in the field as an inspector or resident engineer.

Frequently, the professional sanitary engineer has the responsibility for operation of a sewage treatment plant or water purification plant during the first year or two of operation. The young graduate sanitary engineer would be very forunate to secure the experience of operating either type of plant under the supervision of the professional engineer.

A combination of experience during the early years following the graduation of a sanitary engineer from college which includes investigations and reports, preparation of functional drawings, detailed estimates of cost, preparation of specifications and contract documents, inspection of construction and operation of plants should be ideal background toward the ultimate development of a professional sanitary engineer.

Continued employment and advancement of the young sanitary engineer de-

pend upon character, ability, and opportunity.

The sanitary engineering profession is still rapidly growing and developing. At no time are there complete up-to-date textbooks. In order to be properly informed, it is essential to a sanitary engineer to read the technical literature in his field, attend society meetings, study the data furnished by manufacturers, and inspect works that have been built.

Bound volumes of magazines are available in most large engineering offices and in other engineering libraries maintained by the universities and societies. However, the writer has found it extremely valuable to maintain a reference file of material relating to the particular field in which he is engaged, to clip most of his personal technical magazines, and file the articles according to subject matter. Since the writer has specialized in the field of sewage disposal, his personal file is predominantly on this subject.

The professional sanitary engineer should take an active part in engineering societies. The ASCE and a number of regional engineering societies, such as the BSCE have active sanitary engineering divisions. The water, sewage, and industrial wastes associations are supported to a considerable degree by sanitary engineers and the meetings and journals present much material of factual interest to them. The young sanitary engineer should himself contribute to the professional meetings and technical press by means of articles and discussions.

Much of the work of the sanitary engineer must be done with public funds. The sanitary engineer is required to meet the public and deal with public officials. He should become well acquainted with the operations of municipal, state, and federal agencies and inform himself as to the laws, codes, rules, and regulations under which his work must be performed.

The professional sanitary engineer engaged in public work must work with politicians but apart from politics. It is generally recognized by those holding either elective or appointive offices that the sanitary engineer provides professional services essential to the public welfare and usually his work is carried on without the interference of politics or politicians. Occasionally a sanitary engineer who has served professionally under one administration finds himself person-non-grata when a new administration takes over. This may be regardless of whether a change in political parties is involved and whether or not his services have been entirely satisfactory.

Activities in the sanitary engineering profession have been greatly speeded up during recent years, primarily because of the water pollution abatement program which has advanced on a nationwide scale. A secondary reason for increased activities in recent years is the large backlog of work to be done which had been delayed by depression and war conditions. While a large amount of work has been done in the abatement of pollution by provision for treatment of sewage and industrial wastes, the work yet to be done will require a constantly expanding force of workers in the sanitary engineering field.

A particular problem in pollution abatement is practically never completely and finally solved. Most municipal and industrial treatment works are designed for partial treatment of a portion of the wastes and for a limited capacity not greatly in excess of that required at the time of the design. Works become obsolete, uneconomical to operate, unable to provide the required degree of treatment, overloaded, or run down to an extent that major changes and additions are required periodically.

There is still a tremendous problem in the treatment of industrial wastes so as to abate pollution of receiving waters.

To the writer, one of the most attractive features of the sanitary engineering profession is the variety and scope of the work involved. Practically every problem that arises has some phase that is new and different from previous problems. It is rarely practical to copy directly or follow previous work.

In addition to the technical education, there are other more general qualifications which are of great importance if the young sanitary engineer is to develop into a leader in the profession. These qualifications may include the following: The development of strong moral and ethical sense; a due sense of responsibility; broad social, political, and economic understanding; a liking for and a willingness to work with people, regardless of race, creed, or color; an appreciation of the importance of the work engaged upon; and a certain amount of drive and ambition, tempered by a proper regard for the rights and feelings of others.

Vice-Admiral John J. Manning, in an address to the Student Chapter Conference of the ASCE in Washington in the spring of 1950, advised the young engineer to enter into the field of usefulness and influence in his community, to recognize that his fellow men can offer him as much as he can offer them, and suggested that humility offers a faster road to success than pride and intolerance.

The fullest possible development of the professional sanitary engineer and the depth of satisfaction he will get out of life will depend as much upon his broad development as upon his technical advancement.

ANTIQUE PRESERVER

An acrylic coating for Nigerian pottery is the new preservative system being tried at a Philadelphia museum. A clear, quick-drying plastic, it is claimed to protect surfaces from moisture, rot, fungus and rust. It's also in use, or being tried, as the final preservative in the Eisenhower Museum (Abilene, Kan.), on 1000-year-old Viking ships in Norway, and on the recently discovered 4700-year-old wooden solar ships of Egypt's Pharaoh Cheops.

MORE FOOD FOR LESS WORK

An hour's work today gets the worker about twice as much milk, lamb and ham as in 1929.

TOOLS OF THE TRADE

Although several plumbers' unions sent Dr. Albert Einstein membership cards following his assertion that he'd be a plumber if he were starting all over, a Toledo, Ohio, company did them one better. The firm sent him a kit of four tools—hand threader, pipe cutter, pipe wrench and vise.

TELEVISED PARKING SPACE

Industrial television is now being used to spot empty spaces in car parking lots and as a classroom aid in teaching dental surgery.

AUTOMATIC FLIGHT AHEAD

Underway is a one-million-dollar project to design comprehensive digital-computer control for high-speed military aircraft and guided missiles. Rapid advances in digital computing make possible new plans for miniature digital airborne computers that will make completely automatic all flight and tactical operations. As compact light-weight packages, these will automatically control simultaneous functions such as flight, navigation, engine and fire control.

INDUSTRY BRIEFING

A new industrial program at a major university is expected to open up direct channels of communication between industry and academic research programs. Subscribing companies will receive information on the college's latest engineering and scientific advances at a nominal cost; university and industrial experts will meet periodically to review fields of mutual interest. The program is the first to be made available to industry.

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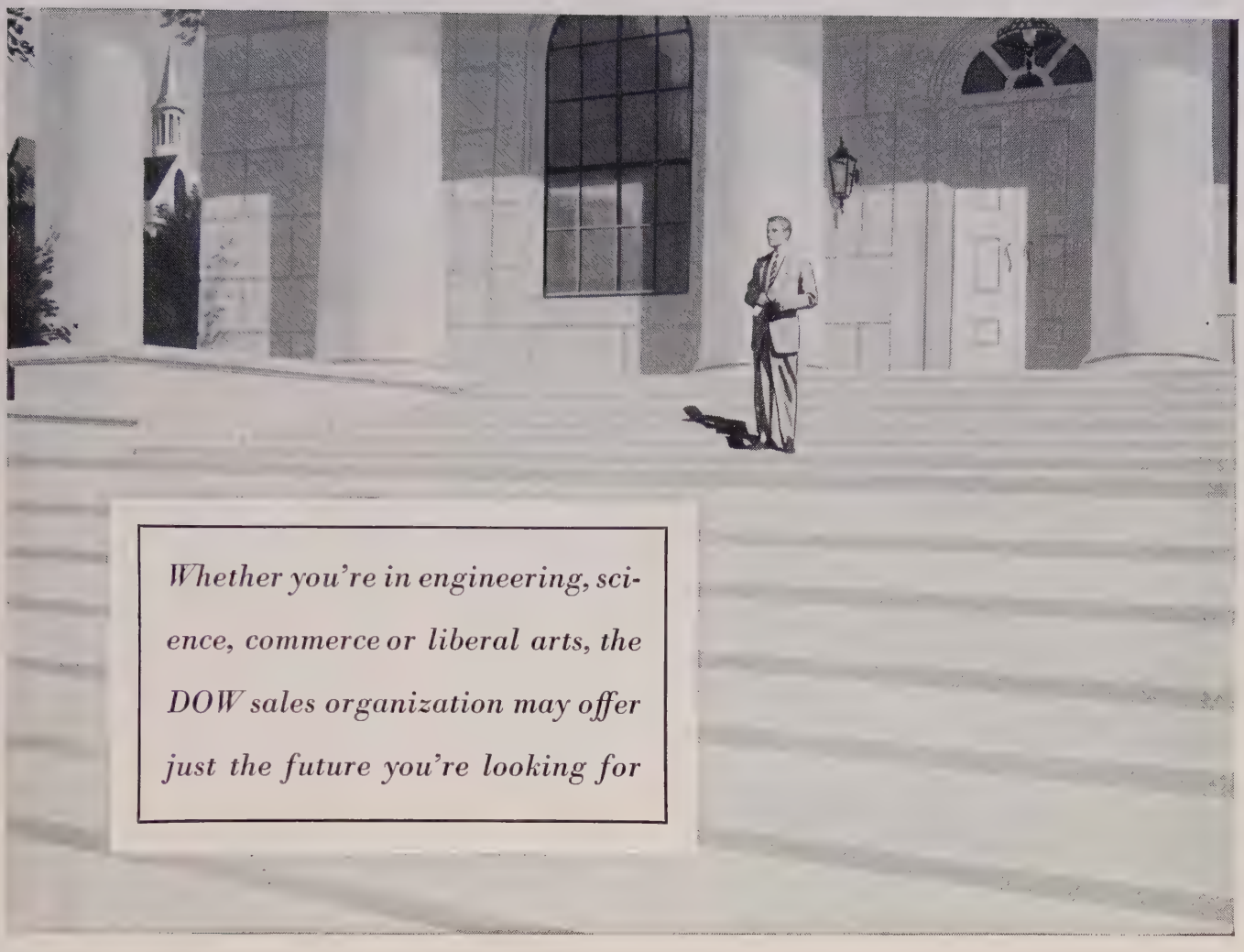
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The Midwestern Universities Research Association

edited by Larry Kiefling, M. E. '56

On September 27, 1954, the Midwestern Universities Research Association (MURA) became a corporation under the laws of the State of Illinois. The present members are the Universities of Illinois, Iowa, Michigan, Minnesota, and Wisconsin, Purdue University, Indiana University, and Iowa State College. The board of directors of the corporation includes one scientist and one administrative officer from each of the member universities. At the first regular annual meeting of the board of directors, a statement of the origin, objectives, and accomplishments of the corporation was formulated.

During the past decade the frontier of nuclear physics has moved into a new area, where experiments are performed not on the atomic nuclei as a whole but on the individual constituent particles of which they are composed, and on particles which are created through high-energy collisions of subnuclear particles. This new field, which has come to be called high-energy physics, is, and surely will continue to be for a long time to come, the major land of the unknown in physics. But as one horizon after another has appeared in high-energy physics, the investment, both in equipment and in scientific manpower, required for effective work in the field, has come to be beyond the reach of the individual university.

The problem of the great expense, in money and manpower, of high-energy physics can be solved if groups of universities will organize and combine forces for the creation of cooperative laboratories. The effectiveness of this solution has been well demonstrated on the East Coast by the Associated Universities, Inc., in the creation and operation of the Brookhaven National Laboratory. There the control of the laboratory is vested in a board of directors elected by the member universities, and the financial support is provided by the Atomic Energy Commission. The AUI arrangement represents a pioneer experiment, and a successful one, toward the solution of the many problems which attend the support, by the Government, of large scale university research, particularly cooperative research involving several universities. A notable degree of success has been achieved toward extending into the laboratory many of the elements of a free university atmosphere, toward making the laboratory attractive to many scientists from all over the world, and toward preserving the valuable interplay between senior scientists and graduate students.

Until very recently, there has been no similar movement on the part of the universities of the Midwest to combine their forces to create a cooperative laboratory for high-energy physics. As a result the Midwest has lagged seriously, relative to both the East Coast and the West Coast, in high-energy physics. The need for such a laboratory in the Midwest is very clear and urgent. There are, in this region of the country, a large number of young physicists who are intensely interested in the field of high-energy physics and who do not have ready access to the necessary facilities.

The first really strong movement in the Midwest toward finding an answer to this need began early in 1953 when some of the nuclear physicists of Midwestern universities constituted themselves an informal committee for the purpose of promoting a cooperative high-energy laboratory and began an intensive series of meetings. From that beginning has grown the present full-fledged Corporation, which has the actice participation not only of the scientists of the member universities but of the administrative officers as well. The task to which the committee, and later the Corporation, addressed itself was fourfold:

(a) to determine, with the help of what little experience existed on the subject, the form of organization that would be the most advantageous for the operation of a cooperative laboratory and to bring such an organization into existence;

(b) to determine what environmental and geographical conditions would be the best;

(c) to gather together, immediately, a group from among those young physicists who would be most directly concerned with using a high-energy laboratory, and to set this group to work studying high-energy machines and designing one for the Midwest;

(d) to take immediate steps to raise funds both for the study program and for the eventual construction of a high-energy machine.

The fourfold task described is a heavy one, but the committee has worked for more than a year with the greatest of enthusiasm and vigor. The administrative officers of the universities concerned have not only given their full support at all times, but have actually worked alongside the physicists in thrashing out the many complicated problems of organization. A cooperative laboratory is not yet on the way, but the committee can point to many accomplishments which represent real progress. These accomplishments are described in some detail in the following paragraphs.

A thought foremost in the minds of the members of the committee was that the responsibility for the kind of research envisioned rests, and must rest, upon the shoulders of the universities. The research is of a kind that reaches out very far in advance of the practical applications of today. It cannot, therefore, derive its stimulus from the practical problems or needs and emergencies of the moment, as is true of the type of research done in many industrial and government laboratories. The universities alone have shown the ability, over long periods, to keep alive and flourishing those lines of research which are truly described as basic, i.e., very far in advance of application. It is therefore the unanimous belief of the committee that in the organization for the projected laboratory, the primary responsibility and also a large measure of the control should be vested in the universities, quite aside from the question of the source of funds. Responsibility and control, it is firmly believed, must go together; neither will be effectively maintained over a long period of time without the other.

The organizational scheme of the AUI was used as a starting point and model, and, as it turned out, only minor departures from that scheme were made. An organization very similar to the AUI was completed and it was incorporated under the laws of Illinois on September 27, 1954. Each member university either paid or pledged $10,000 to be used as an operating fund. Considering the fact that all of the universities involved are tax-supported institutions, and that in several cases their joining a corporation outside their own states required an act of the legislature, the successful formation of a corporation attests to the seriousness of purpose of the committee.

It was fully realized that the ques-

tion of the location of a Midwest laboratory would be a complex one, for the reason, among other considerations, that one laboratory already exists in the Midwest which is authorized to enter into cooperative work with the universities, i.e., the Argonne National Laboratory. Nevertheless the committee tried to approach the question on a new basis and to at least attempt to define the most advantageous set of conditions. The importance of proceeding in this manner is pointed up when one recalls that the choice of the location of Brookhaven, which was influenced to a large extent by the availability of a piece of government-owned real estate, proved to be a serious deterrent to the laboratory's development during the early years. The location has only recently been reduced to secondary importance by the uniqueness of the research tools which have become available. The committee therefore takes a strong stand, and will try to maintain it, that a cooperative university laboratory, which is to be built for many decades of use, should not start life with a handicap in location or environment.

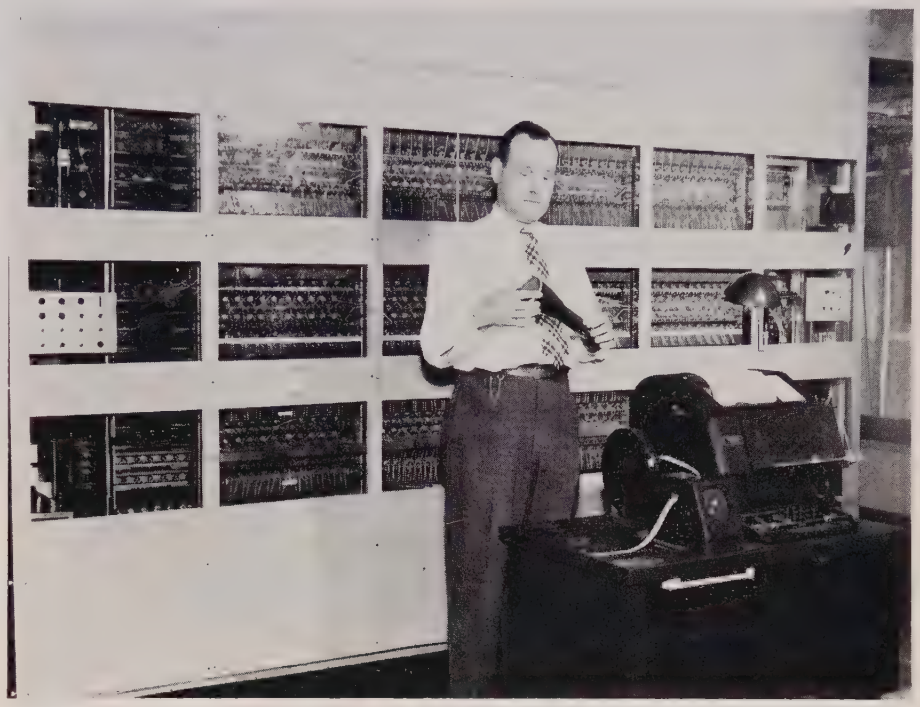
The most important requirement in respect to location is, in the opinion of the MURA group, that the laboratory be in a place which is attractive to university scientists. A laboratory is only as good as the scientists who use it. Since a cooperative laboratory would rely heavily upon university scientists going to it for a summer, a semester, or a year at a time, the willingness of university people, and in particular their families, to move to it for these periods is of vital importance. Much would be contributed to the success and value of the laboratory if it could be located in, or close to, an established community of scholars having a variety of fields of interest.

Another important requirement, which is connected with location as well as with organization, is that security restrictions be held at an absolute minimum, making the interchange of scientists and of information with other laboratories and with friendly nations as free as possible.

A study and machine design group, sponsored by the committee and now by the Corporation, and under the chairmanship of Professor Donald W. Kerst from the University of Illinois, has been active since the very beginning in the summer of 1953. With a membership ranging from 10 to 20 from the member institutions as well as from Argonne National Laboratory, the University of Chicago, and Wayne University, it has met for a three-week and an eight-week session at Madison, and for sessions of two or more days at monthly intervals at the various universities. For the present school year it will continue, meeting for two days of every week, with a center of activity at Ann Arbor.

In addition to group meetings, experimental projects on specific problems relating to machine design are being carried on at a number of the member universities. An intensive program using the Illiac (electronic computer) has been under way at Illinois for the past year. Experiments on the design of the radio-frequency accelerator system for a large machine are under way at Iowa State College. Magnet design studies are beginning at Purdue, and electromechanical analot work has been in progress at Michigan for the past year. At Minnesota work is being done on the problem of injecting protons into an AG machine by means of a linear accelerator. The amount of experimental work specifically aimed at the design of a machine is steadily increasing. Scientific contributions by the Midwest study group have already been significant and of value to other laboratories planning high-energy machines. The work is described in detail in numerous technical memos which have been written and distributed over the past year and a half. In addition, the most recent work will be presented in several talks scheduled for the New York meeting of the American Physical Society in January, 1955.

Among the specific accomplishments of the Midwest study group, the one which has attracted the greatest interest is the invention and theoretical exploration of a fixed-field, alternating-gradient (FFAG) accelerator. Briefly, it was found that narrow ring magnets can be made which can simultaneously contain a high-energy orbit, for example a 20 Bev (billion electronic volts) orbit, and a low-energy orbit of about I Mev. This means that the magnet can be operated continuously on direct current thus avoiding the complex power equipment needed to pulse a magnet. It also simplifies the radio-frequency modulation, which in the case of the more conventional pulsed magnets must be very precisely controlled to track with the magnetic field. With the new FFAG magnets an arbitrary frequency modulation program may be used. Since the magnet is always able to receive particles, a pulse of particles can be injected as frequently as the radio-frequency modulation cycle can be repeated. Thus the average beam current can be much higher than that from a conventional machine, whose magnet is pulsed.



Professor Ralph E. Meagher examines one of the cathode-ray tubes which composes the memory of the ILLIAC. The ILLIAC is being used extensively on computations of orbit stability.

About six different types of FFAG accelerators have been worked out. Some involve reverse field sectors and some involve ridges on poles or prismatic edges on magnet sectors. A unified theory which describes all the types so far imagined and suggests other types has been developed, so it may soon be possible to determine the optimum physical design for an ultra-high-energy machine.

It will require more theoretical analy-

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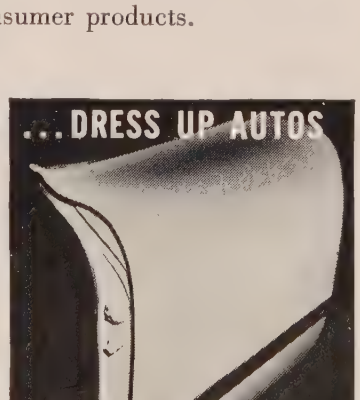

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sis in order to determine whether or not the FFAG magnet will have an overall advantage over existing designs in the 20 Bev range; however, it has already become clear that there will be important applications of the FFAG principle to the better-known accelerators at lower energies. For example, betatron acceleration with an FFAG ring magnet used for the guide field will make possible an intensity increase of several orders of magnitude, and existing FM cyclotrons can be changed to give higher current by the application of the spiral ridge form of FFAG poles. An early experimental test of the FFAG principle will therefore be of great importance to several branches of nuclear physics. The MURA group is laying plans for such a test in the very near future at the University of Illinois, using one of the betatrons.

Another activity of the study group which deserves special comment is the development of new computational methods, which make possible rapid experiments on orbit stability, using the Illiac electronic computer. Transformation have been discovered which have not only greatly accelerated the digital computer work, but which have made it possible to explore the more general nonlinear cases which are practically inaccessible analytically. Orbits can now be run through so quickly that the results can actually lead, rather than follow, the conjectures and speculations on modifications of design. Analytical work supporting, and feeding into, the digital computer program is carried out at the Universities of Iowa, Illinois, Wisconsin, Indiana, and Wayne University. This theoretical work is putting MURA in a position to answer some of the difficult questions about general (nonlinear) forces which arise in the conventional AG machines as well as in some of the especially interesting machines recently devised by the members of the MURA group.

The matter of financial support for the MURA objectives has been pursued continuously. So far no support for the construction of a laboratory has been obtained, but adequate support for the study group has been made available from several sources. In the early months of the study program, support was provided by the Atomic Energy Commission through its contracts at Argonne and Brookhaven, and by both the Atomic Energy Commission and the Office of Naval Research through their contracts at some of the universities. Since the spring of 1954 the outside financial aid has been provided entirely by the National Science Foundation.

The member universities have contributed substantially from the time of the early stage of the organization. Faculty members' time has been released freely and in many instances travel expenses have been paid by the universities. The University of Illinois has provided services of its electronic digital computer "Illiac," which has by now has amounted a very large number of hours. The University of Michigan, through its Phoenix Project, has provided a special fund to cover the expenses of its scientific participants and for experimental work at Michigan. To provide for business expenses of the Corporation each of the eight member universities has contributed $5,000 and has pledged another $5,000.

Professor Donald W. Kerst with the original betatron which he constructed at the University of Illinois in 1940 and the 300 MEV betatron.

Will You Become a Good Engineer?

by D. B. Keyes

You young men will be given much sound, practical and concrete advice about how to look for and how to secure a job. I am going to take the calculated risk of telling you bluntly what is on the minds of many of us when we evaluate you as potential employees. We disguise this interest with carefully worded sociological and psychological questions, but what we want to know, what we must learn, is: Do you really want to be an engineer?

There are many opportunities today for the young man who sincerely loves his profession and can demonstrate his abilities. There always are. The men I know who graduated during the early thirties in the midst of the depression thought they had a pretty tough time, but 90% of them were located in positions within six months after graduation. Many of them now hold very responsible positions in industry and in the technical world. Their chief characteristic then, as now, was that they really loved their profession.

Today, however, there seems to be generated in the minds of our college graduates, especially our engineers, a philosophy peculiar to the times. Personnel directors interviewing men in our colleges tell me that you are inclined to inquire first of all, not about the character of the job, but about pension plans and fringe benefits.

Even if you have a pension in your old age, it will probably appear inadequate from your viewpoint. A research engineer who recently retired as the executive of a large corporation told me that now, although his retirement allowance is $45,000 a year, he is forced to continue to work for a living. Over the years he has acquired some rather expensive tastes and; because of the tax situation and inflation, he cannot maintain his standard of living on his present pension, even though the size of his pension may look large to most of us.

Financial security must not be your

primary objective. A rewarding career is dependent upon this fundamental consideration: Will the type of engineering you have elected offer you the incentive, the curiosity and the urge to work hard and "go places."

It has been my privilege to know quite a few distinguished engineers. Looking back over the years, I know of only one of my acquaintances who seems to have acquired real financial security. The state takes care of him and will do so as long as he lives. He paid a very high price for this security, but in fairness to this individual, I must say that he did not wish it this way.

On the other hand, taking a typical example of one of my friends who has been very successful in the engineering field, I know of no time when he was actually financially secure. After working up as general manager of a company, he decided that the future of this company was not too good; it was in a very specialized field. He then became a college professor.

It was quite obvious to me that, although he was one of the finest professors I had ever had the pleasure of listening to in the engineering field, he would be unhappy if he stayed in that position too long. Evidently, his thoughts were along similar lines, for during World War I he became the president of a war company. With the aid of a very competent staff of young people, he developed this company to such an extent that it became one of the greatest chemical companies of its day. The financial backers of this company, however, did not appreciate the vision of my friend. When he discovered that he could develop the company no further, he promptly lost interest, resigned, and became a consulting engineer.

It wasn't long before another concern, wishing to develop the chemical end of their business, hired my friend. For many years he gave all that he had to the development of this group. His success was phenomenal, and today this company is one of the truly great chemical concerns in the world. He remained active, upon request, long after his retirement age. When he finally retired, he still retained an active interest. Today he is still active and still very happy.

At no time in his career, as far as I know, has he ever sought to work for his own financial security, but has given his all to the development of every organization with which he has been connected. It should be remembered, too, that he liked what he was doing, and when he didn't, he changed to a new job that he did enjoy.

Shortly after World War II, another friend of mine, prominent in war work as an engineer, joined one of the smaller research units of a large company. After three months he quit. He could not stand the "atmosphere." He found men in their early twenties who were not interested in creating anything. Merely interested in their pay, their fringe benefits, and their old-age security, they were actually looking forward to the time when they could retire and quit working for a living. He told me that this atmosphere just got on his nerves, so much so that, although he was older than his colleagues and liked his particular job, he could not work there any longer.

One of the best examples of a successful industrialist, an engineer whom I knew in the old days, was Herbert Dow, the founder of the Dow Chemical Company. If one reads the history of this company, one is impressed with the fact that its founder not only was seemingly uninterested in personal profit, but in the profits for the company. He took the attitude that a company's growth depended on its ability to produce new products useful to the public at a price the public could afford to pay. He apparently reasoned that if one was successful in creating these new products at a price, the profits would come automatically—which they did. Today, the Dow Chemical Company stands out as one of the truly great creative and profitable enterprises. I doubt whether the late Herbert Dow ever envisioned the enormous growth that has taken place as a result of his simple and practical principle.

The same principle was applied by another friend of mine, who started his first company with $243 when he was seventeen years of age, and developed an "empire" worth, at the time of his death, over $25 million. This man told me on several occasions that the love of creation, and not of money, was his guiding principle. He told me that large profits obtained in a single year through the sudden development of a new product were always embarrassing to him, as his stockholders expected him to reinvest this sum immediately to make an equal percentage profit—something that usually cannot be done.

Permit me to point out that the philosophy of these two men, so dissimilar in background and education, was a desire to seize every opportunity to create for the benefit of the public. They obtained their enjoyment in hard work and during their working hours. If either one of them at any time had fringe benefits of any description, I certainly do not know what they were.

The enormous amount of energy Edison spent not only in creating but in promoting electrical engineering developments in order to satisfy the public is still appreciated. Many years ago the courts decided that the Edison patents on the moving picture machine were the basic ones, although three satisfactory moving picture machines had already been invented and developed by other persons prior to Edison's. But these three had been "abandoned." The court pointed out that Edison had not abandoned his invention but had spent an enormous amount of time, energy, and money in seeing to it that the public received the benefits. It was no more than human for the court to agree to give credit to Edison rather than the prior inventors. Creation for the benefit of the public is what the public wants and incidentally, what they are willing to pay for.

One must not only love engineering, but use one's knowledge and energy for the creation of something that is directly or indirectly of benefit to all.

My suggestion to you who are graduating from our engineering colleges is to be certain when you discuss a position in industry to find out just what it is you are supposed to do on the job and then determine for yourself whether or not you would enjoy doing that particular type of work.

If by chance you know what you would like to do, be sure to tell the personnel man your thoughts. He is eager to place you in the position in which you will do well, for his success as a procurer of young engineers depends on his ability to discover your basic interests and to place you in the position which will give you the opportunity you desire.

The capable young man with a sound educational background, with the desire to augment his knowledge throughout his lifetime, with a love for his work, and with an ardent desire to create for the benefit of mankind, should find unlimited opportunities in the engineering fields.

Do you really want to be an engineer?

"May I have this dance?" asked the freshman.

"I'm sorry, but I never dance with a child," she said with a superior sneer.

"Oh, a thousand pardons," he said, "I didn't know your condition."

* * *

Patient: "I'm in a terrible mess; the doctor said the only way to cure rheumatism is to stay away from dampness."

Friend: "What's so tough about that?"

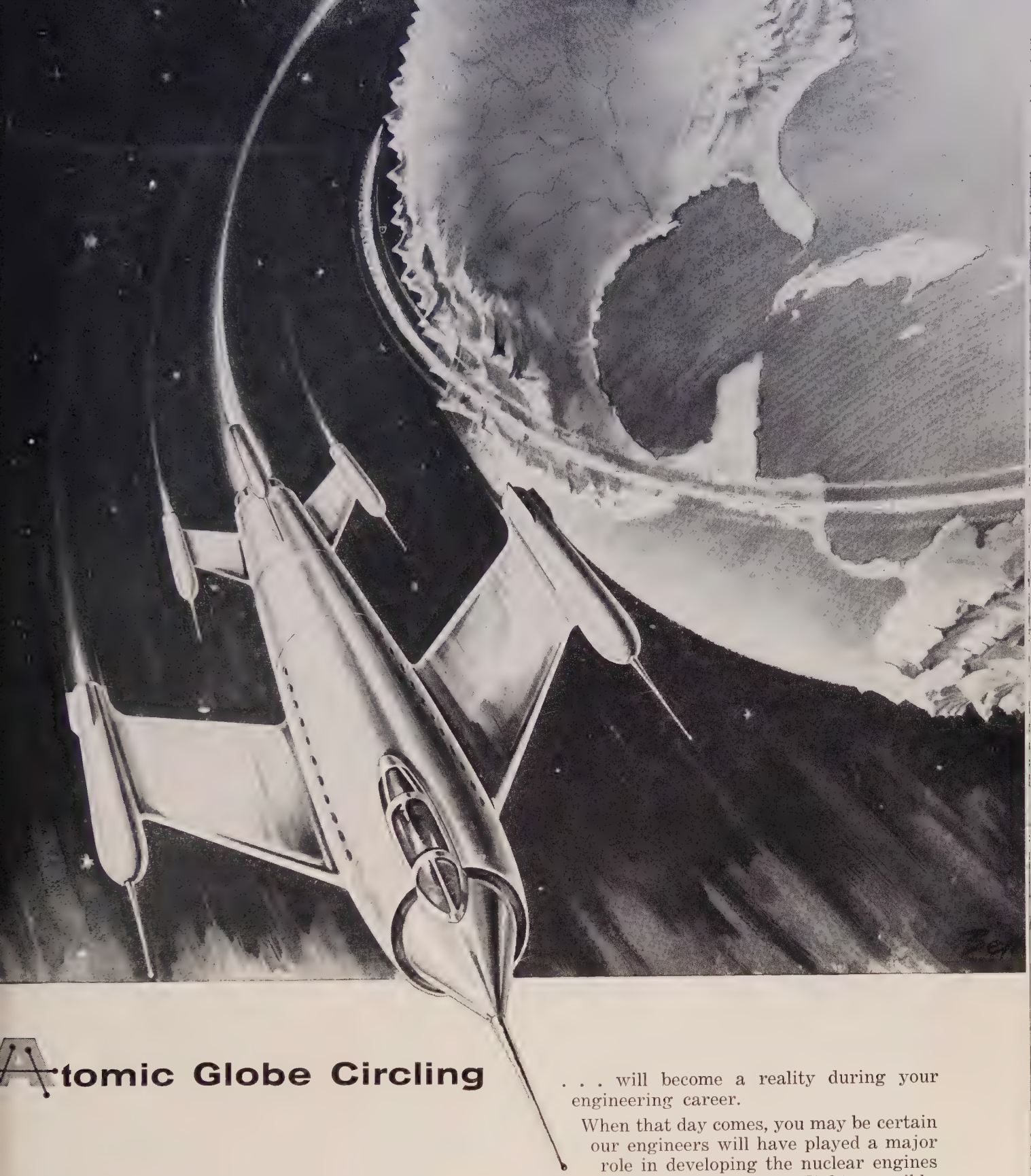
Patient: "You don't know how silly I feel when I sit in an empty tub and go over myself with a vacuum cleaner."

* * *

The editor of this column points with pride to the clean, white spaces between these jokes.

* * *

An extreme optimist is a man who sits in the back of a burlesque house and winks at the chorus.



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Germany's Greatest Ace

by Jim Piechocki, Aero E. '56

His name was Richtofen. The Baron Manfred von Richtofen. Most people have never heard of him of his exploits, but in his day he was the greatest pilot ever to slide into a clockpit and snap on a kepi. More than that, he was the most feared man in the skies during the courageous days of flying, the World War I era. The eighty planes he claimed in battle still is a record. Think of it. Eighty British and French planes shot down by one man!

JIM PIECHOCKI

Jim, a junior in his second semester on this campus, has previously written articles for the TECHNOGRAPH while at Navy Pier. He is now busy in organizing an openhouse program for the Aerodynamics department.

His day was the day of dancing biplanes, struts and wire braces, flapping fabric, and open cockpits. His secret was to attack by surprise. "Just let me get above and to the rear of them and they are mine," he once said to his fellow officers of the German Imperial Air Service. Richtofen fought because he loved to hunt. The hunting instinct and a great love for horses was instilled in him by his father, a major in the reserves with a great military past of his own. The little village of Schweidnitz, Germany, in the shadow of the mighty Uhls, the birthplace of the Baron, was the scene of many of his youthful hunting victories. His home later became a shrine filled with many trophies, which included everything from the head of a wild bull to the battered pieces of British aircraft.

He was not always a flyer. His great love for horses prompted his enlistment in the German cavalry. When the great war began, the Baron participated in the siege of Kielce, one of the earliest attacks of 1914. But he soon became disgusted with cavalry life, for he found that all glory of the charging horde was submerged in the trivial administrative duties of policing a town of illiterate peasants. Weeks later, he was transferred to the trenches, where he won his first decoration, the Iron Cross. Still dissatisfied, he applied for flight training. It was rumored that adventure was to be found in the air and this was what the Baron wanted. He got his transfer, and by December, 1914, he was flying as an observer in the old "applebarges" or reconnaissance bombers over the Belgian front. His duties were that of watching the instruments, checking maps, and doing everything possible to lighten the burden of his pilot, Zumer, who literally had his hands full in keeping their clumsy Albatross aloft.

These were truly the chivalrous days of flying, for enemy planes usually circled battle zones alongside each other for hours without any idea of attacking. Then someone got the urge to take a carbine aloft and try their luck with a few pot shots. Richtofen tried it too. While flying one day over the Champagne front, his pilot pulled their two-seater alongside a large French Farman reconaissance ship. When the French observer saw the Germans' intention, he produced a carbine of his own and soon both ships were exchanging broadsides like two galleons of old. Suddenly the Farman dropped into a spiral dive, pancaked on the rugged terrain below, and rolled into a shellhole, finally coming to rest with tail pointing skyward. For the Baron it was a thrill beyond description, a new hunting victory. What a story this would make back at the airdrome tonight! It was more than a story, however, for it raised secret hopes in the Baron for another transfer, this time for pilot training, and the smaller, faster *eindecker* scouts. Zumer began readying Richtofen for his first solo.

It was a cold, cloudy day in October 1915, when Manfred stepped alone into the cockpit of a plane for the first time. A few officers stood at a distance and watched the plane roll slowly along the runway and lift itself into the air. After the required number of passes, Richtofen brought the ship in for the crucial test, the landing. The craft glided in at a steep angle, slapped the runway, and bounced crazily along until a wingtip scraped the turf. The son of nobility, the man who was to become Germany's greatest ace, the Flying Uhlan, the Circusmaster, the Red Knight, had crash-landed. It was only through the patience of his superiors that Manfred achieved pilot's rating on Christmas day, 1915.

By March, 1916, Richtofen was back at the front. Almost immediately he got above and to the rear of a speedy little French Nieuport and brought it to the earth in flames. He accomplished his first kill under the watchful eyes of Boelcke, the German god of the skies with over a score of victories to his credit. Richtofen secretly wished he could fly on the very active eastern front, where it was rumored that the British were inflicting heavy casualties in the air. Only a few German pilots, Boelcke being one of them, were having any luck against the superior forces of the British. But this was soon to change, because Boelcke himself was organizing a squadron of crack pilots whose main purpose was to smash enemy air superiority to the East. The great Boelcke himself visited Richtofen in his quarters and invited him to fly in the new squadron. With a hearty laugh and a sudden clasp of hands, Richtofen became a member of the most feared group of fighter pilots ever known—*Jagstaffel No. 2.*

Under the watchful eyes of Boelcke,

On September 27, 1917, Richtofen ran for the first time to his new ship—the all-red, triple decked Fokker tripe.

Manfred, a good pilot, became a great one. He listened carefully to the wise suggestions of Boelcke, whom he deeply admired. Boelcke had a quality of personal magnetism which made him well liked by both enemy and ally. He spent many hours visiting the hospitals which held many of his crippled victims. And he and the Baron began a reign of terror from the very first day that his staffel flew into the Somme basin in late September, 1916. On their first sortie, Manfred bagged an old British F. E. He landed afterwards and reached the battered craft in time to see the observer die. The pilot was mortally wounded. Back at the airdrome and amidst a wild celebration, Richtofen slipped away and went to a small hospital in Cambrai. Behind the building he paused before two fresh graves and bowed his head in admiration. Two years later Englishmen would bow their heads in his honor.

The war was going in favor of the Allies. By late October, 1916, the British had attacked Albert and were victorious on the Commercourt salient. With a new frenzy they hurled their forces into battle at Bazentine, Pozieres Ridge, and Delville Wood. Like thousands of ants they swarmed into Thiepval and the Translay Ridges, and Richtofen sent his sixth victim hurtling to German soil. On October 28, tragedy struck the staffel. The great Boelcke was killed in an aerial mishap when he collided in mid-air with a plane from his own squadron. The country mourned the death of their hero who had forty enemy planes to his credit, and had flown by the side of and was decorated with the famous Immelman. Boelcke was buried with his highest decoration, the *Pour le Merite*. High over Cambrai British planes dropped wreaths in his honor.

The Baron's eleventh victory came November 23, and with it he avenged the death of Boelcke, for his victim was Hawker, Britain's greatest fighter-pilot. It was a gruelling, circling skirmish that started at 11,000 feet and ended only a few feet above German territory. Manfred landed near the battered Vickers scout. He removed Hawker's guns and had them placed in his home at Schweidnitz. He commemorated each of his victories with a tiny silver cup inscribed with the type of craft downed and the date of the encounters. At this point, Manfred's brother, Lothar, was transferred to the Air Service and began flying with the Baron, who was now the proud wearer of that blue-pointed cross with the golden eagles— the *Pour le Merite*.

Richtofen's aerial success now came rapidly. He was placed in command of the squadron, which was renamed *Jagdstaffel Boelcke*. By December, 23, he had accounted for sixteen enemy planes. Now the color rage began. Pilots had been experimenting with various color schemes in an effort to camouflage their craft. But here the Baron made a bold stoke on the side of individuality. He ordered his DIII Albatross scout painted a brilliant red. Every strut, brace, and hidden corner was covered with the flaming hue. Now those plucky sons of England would know whom they were fighting. Others followed suit. German pilots had their planes painted with shining blues, yellows, and whites. Combinations of red with green or blue noses, black and white checks, yellow and black zebra stripes, and multi-colored spangles were used. But the all-red scheme was reserved for the Baron, and it earned him the title of the Red Knight of Germany.

Now badly outclassed in the air, the British came on in every conceivable type of ship that they could get in the air. They used the slow and clumsy F. E.'s and the venerable R. E. 8's, which they nicknamed the "Harry Tate." "We were cold meat," cited one British pilot, "and the worst part of it was that we knew it." German pilots, with their fast, single-seater bipes, capitalized easily. Early in 1917, Richtofen was placed at the head of newly organized *Jasta II*, a collection of battle-wise old hawks who roared into the air for the first time on January 23. Within a month he had increased his magic total to twenty-five, interrupted only once by a British bullet in his engine behind his own lines. By March 22, he had downed his thirtieth.

And still the British came on. In the battle of the Ancre salient, the Germans lost heavily. They were in a general retreat along the Ancre, and the British were approaching before Baupame. Continuing their drive, German retreat was forced along the 100-mile line of the Noyon salient from north of Arras to near Reims, to the prepared Hindenburg line. The plucky sons of England, still hopelessly outclassed in the air, continued to carry the war to their foes, but just as coming events cast their shadows, so too was Richtofen beginning to detect the end of German air power. New British planes were on the way. His thirtieth victim was a new Spad claimed after a long circling battle. Yes, the planes of John Bull were improving.

The famous men of *Jasta II*—Wolff, Allmenroder, Lubbert, Schaefer, and the two Richtofens—seemed unmindful of the improvement in enemy craft. During the month of April, 120 British planes were shot down, as compared to thirty for the Germans. By April 8, Manfred's total had run up to forty. He had equalled the record of Boelcke, and the whole nation awaited his next victory. His superiors were pressing him to take a vacation after his forty-first success. It was in almost complete difiance of "the records" that Manfred flew off and returned on April 11, modestly announcing that he had scored a "triple." He

had effectively evaded his superiors' demand that he rest. That evening at the airdrome, his *staffel* toasted him a countless number of times, and the Baron retaliated with a toast to Wolff, who had gotten four English planes that same day. And far behind the lines, a Berlin jeweller put the finishing touches on Manfred's forty-third little silver victory cup.

Now the tide of battle suddenly changed in the air. With "bloddy April" over and the Baron personally accounting for twenty-one in that period, a decided change came about. The spring line of British planes reached the front. These included the Sopwiths and remodelled Nieuports, very fast little scouts which made the Baron's battles just a little longer. Faster turns, a few more tricky twists, and victories now came only after great effort. The Baron, however, still managed to catch up with the Sops, and when he downed four in one day at the beginning of May, the Kaiser himself telephoned and offered his personal congratulations.

On May 1, Richtofen took the vacation demanded of him. Far behind the lines word came of his arrival and when he reached Cologne he was met by hundreds of officers who smartly saluted him and offered their congratulations. Pretty frauleins presented him with wreaths of flowers and were delighted with this shy young man who blushed furiously in their presence. The Baron was then whisked off to see the Kaiser, who congratulated him on his twenty-fifth birthday. He then met with von Hindenburg, von Ludendorf, General Heppner, Balin, and Helfferich—when who were shaping the fate of Germany in the war. At her own request, the Baron visited the Kaiserin. The empress was very curious as to how his plane worked, and the Baron took great delight in explaining the intricacies of flight to her majesty. Next he flew to Freiburg where he hunted pheasant and red elk. It was here that he learned that Lothar had fallen into a British aerial trap and was shot down seriously wounded. Lothar, an ace in his own right with twenty planes to his credit, was secretly admonished by the Baron for his stupidity.

When the Baron returned to the front, he found the scene changed. Familiar faces were missing. The news of Lt. Schaefer's death shocked him. Wolff was dead. On June 17, Zumer, the man who taught Richtofen to fly, died in a fall from his plane. Young and inexperienced men were filling the spaces vacated by his old friends. Tactics were changing also. The German government claimed that individual combat was proving too costly, hence they formed the *Jagdsgeschwaders,* or massed flights which roamed the front like a pack of hungry vultures. These flying circuses, as the British called them, created new aerial combat techniques. Any poor souls who happened to run into one unescorted usually encountered a dizzy blur of biplanes circling madly around with his own tail as the prized object. These circling battles received the name of "dogfights." Richtofen was placed in command of a newly formed massed squadron, and he immediately resumed his winning ways at his new post of "Circusmaster."

On July 6, Richtofen's circus spotted a flight of six F. E. 2's which had strayed beyond their own lines. The Baron led the attack with forty Albatross bipes following. He turned head-on into one stray with his twin Spandaus guns chattering away. He saw fabric fly up around the enemy observer. Then it happened. A burst from the F. E. exploded in his face and all went black. With his engine dead and his sight practically gone, the Baron glided his plane earthward. The mighty Circusmaster, conqueror of fifty-seven planes, hit the ground sharply. He awoke several hours later in a hospital to find that his skull had been creased by a British bullet. It was his first and only serious wound of the war. After three weeks of convalescence, he was back at the front, a changed man. His confident attitude was replaced by an air of grim caution and the horror of defeat, previously unknown to him, tugged at his mind. A white bandage could be seen beneath his kepi.

Manfred von Richtofen, Germany's greatest ace.

And still the Allies came on. The English had captured Wytschaete, and activity was renewed in the Ypres sector. The battle in the mud of Flanders raged on. And the Baron claimed number fifty-nine on August 26.

At this time, young Tony Fokker, Germany's brilliant designer, presented Manfred with his latest model, the famous triplane. After testing the triple-winged ship, the Baron said he liked it and would use it. It was a marvelous craft, highly maneuverable, and was naturally painted a brilliant red. It was on September 2, 1917, that Manfred eagerly ran to the ship where a mechanic had finished preliminary preparations. He took his new tripe up and headed with *staffel* toward Zonnebeke. There they spotted a lone "Harry Tate" and the Baron dropped down very close and to the rear of it. The British observer, never having seen an enemy triplane, thought it was a Royal Navy craft and waved a salute. Richtofen pressed the trigger of his twin Spandaus and raked the British plane with bullets. His sixtieth victim fell in a familiar spiral dive. The Berlin jeweller made another little silver cup, the last one for the Baron in the face of Germany's rapidly dwindling silver supply.

Now the British made a daring move. The Royal Flying Service was combined with the Royal Naval Air Service into one air arm and called the Royal Air Force. The R. A. F. was placed under the control of a special secretary of state whose status was equal to that of the head of the army or navy. Women were placed in mechanics' positions in an effort to release more men for air service. Investigations pried into military affairs, and inquiries were held concerning the worthiness of certain British craft. Aeronautical research was directed toward the improvement of the scout plane. Sopwith Camels and S. E. 5's were developed. The Sop was then improved into a type called the Dolphin, and later into the English pride of the air, the Snipe.

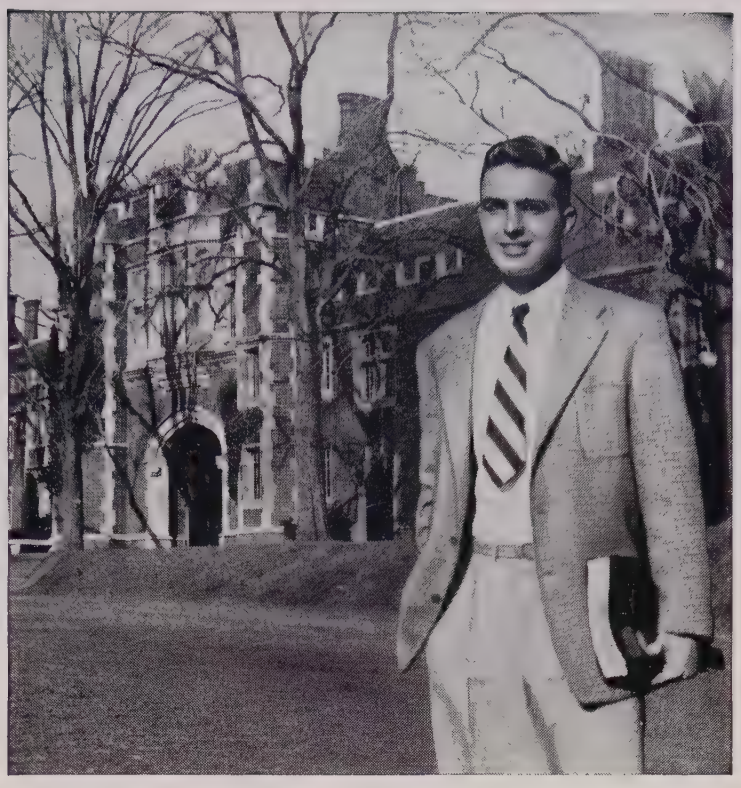
Russia surrendered to Germany, and on March 18, 1917, the Baron bagged number sixty-six, a speedy Sop Camel. By March 21, Germany's big push was on. They overpowered British forces at St. Quentin and roared down the road to Guiscard. They swept past Ham and Perone. They battled their way through Bapaume, through Boyelle, and on to the river Cojeul. The air war over Picardy was savage, and the Baron, back to his old tricks in familiar territory again, was showing particular interest in the new Sops. His black list now contained seventy-three markers.

A running account of Richtofen's next spurt of successes reads like this: March 28, number seventy-four; April 2, seventy-five; April 6, seventy-six; April 7, numbers seventy-seven and seventy-eight. Just thirty-five minutes after his last victory of that day, he turned on a Sopwith Camel piloted by an eighteen-year-old Englishman and destroyed it. It was his eightieth and last victim. The reign of the Red Knight was at an end. The next Camel would get him.

Captain Roy Brown R. A. F. Squad-

Donald C. Pote asks:

What bearing would my field of training have on my assignments at Du Pont?



DONALD C. POTE will receive his B.S. degree in Mechanical Engineering from Princeton University this June. He's been quite active in interclub athletics—football, basketball and baseball—and served a term as Club Athletic Director. He's also found time to work on "The Princeton Engineer" as Associate Editor. Right now, Don is making thorough plans for his employment after graduation.

CHARLES H. NOREN received his B.S. in Mining Engineering from the University of North Dakota before he entered the U. S. Air Force. Later he returned to school for an M.S. from the Missouri School of Mines, received in 1948. During the course of his Du Pont employment, Chuck Noren has had a wide variety of job assignments. At present he is engaged in a fundamental research project concerned with commercial explosives at Du Pont's Eastern Laboratory in Gibbstown, N. J.

"Chuck" Noren answers:

The answer to that is easy, Don, if you mean *initial* assignments. Generally speaking, a graduate's first assignment is influenced by his previous training and his expressed interest in a particular type of work. Whenever possible, Du Pont assigns a man to the type of work he is trained for and wants —he'll do better in any field if he's highly interested. For example, my master's thesis was on the use of explosives, and my first Du Pont assignment was a study of the efficiency of explosives.

But experience on the job really constitutes *new training.* You learn about other branches of science and engineering—you broaden your horizons through daily contacts with men having other skills. The result is that arbitrary divisions between technical branches gradually dissolve, and you become ready for new assignments and new responsibilities—even outside your original field. In my own case, I developed quite a bit of skill in mechanical and civil engineering techniques when I was called upon to supervise the "shooting" of an experimental tunnel for the evaluation of new explosives—even though my original training was in mining engineering.

Of course, specialization in a definite field may be continued if the man specifically wants it and reveals a talent for it. The best opportunities for that are in research and development. Naturally, the value of this kind of work is also recognized at Du Pont.

So, no matter what your initial assignment may be, Don, Du Pont is anxious to bring out your best. A good rule to remember is this. A graduate's *first* assignment is often necessarily based on his field of training and his degree, but his subsequent progress at Du Pont is *always* based on his demonstrated ability.

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ron 209 was a very sick man. The rigors of two daily flights against the circuses had shattered his nerves. But his troubles were momentarily forgotten when he saw "Wop" May, and old buddy from his training days, walk into his room. They laughed together and Brown soon discovered that May had been transferred to his squadron but was grounded for failure to report to duty on time. May begged his friend to use his influence and talk the "old man" into letting him fly the next day. On April 21, 1917, at 10:30 a. m., fifteen cherry-nosed Camels darted across the runway at Bertangles and headed east. Brown was in the pack and on his right was a young lieutenant named Wilfrid "Wop" May.

In a matter of minutes they spotted trouble. Flying at 15,000 feet, they saw a group of "Harry Tates" being mercilessly attacked by four Fokkers two miles below. Should they drop down to help out or were their more Fokkers about? It was Brown's decision. He wagged his wings, kicked over the rudder, and nosed his ship down. When the fifteen Camels were 1,000 feet above the melee, another swarm of Fokkers, twenty-two of them, swooped from out of nowhere and joined the scrap. The dogfight was on. May, warned to stay off at a distance if serious trouble was encountered, singled out a stray, got on its tail, and finally sent it down in flames. Brown, in the meantime, found himself in the middle of a mess looking for a way out. But the strong east wind had already pushed the huge, circling battle to the west and the German ships were beginning to turn and head for the safety of their own lines. But one Fokker, a bright red triplane, stayed behind. Brown spotted the red ship on the tail of poor May, who just wouldn't stay away from trouble. By the time Brown caught up with the speeding pair they were deep in British territory. The trio were travelling at an incredible speed and very low over the terrain when Brown opened fire on the triplane. The red ship veered off suddenly and went sprawling to the earth in a grinding crash. This was the way the Baron died near the village of Sailly le Sac, in the valley of the Somme.

That same afternoon a small group of soldiers carried Richtofen's body to a small cemetery near Bertangles. A freshly dug grave awaited. Shells boomed in the distance as an English chaplain spoke a few prayers. An officer barked a command and the assembly of soldiers snapped to attention. Rifles were raised. Three vollies rang out from the guns of the men the Baron fought so admirably. In a few months the war was over and the man who once was the toast of Germany became just another casualty.

Meet Mr. Bunche

by Frank Krbec

Ralph Johnson Bunche was born in Detroit, Michigan, on August 7, 1904. His mother was a musician and his father, a barber. The untimely death of his mother sent Ralph to live with his aunt in New Mexico. His devoted love for learning inspired him to enroll in college and his choice was the University of California at Los Angeles. With him he carried an outstanding record from his Detroit high school and soon it became evident he would do just as well in his new location. You can't keep a man like Ralph Bunche down. No task became difficult when he assigned himself to the job. Whether he was doing outstanding scholastic work or out on the field distinguishing himself in sports, he was an example to watch. He got through college holding several jobs as a janitor, part-time carpet layer, and assistant in political science along with a few scholarships. He graduated "summa cum laude" from the University with a Master's degree and was a member of Phi Beta Kappa.

His career was a brilliant one. For his doctor's thesis he went to Africa to write a prize winning paper on the governmental aspects of several of the mandated countries. He accepted the opportunity to teach after receiving his Ph.D. from Harvard in 1934. Turning from the academic world he accepted the post of the secretarial of the United Nations Palestine Commission regarded as the most important and critical assignments in U. N. history. Before this appointment came, Bunche served with the U. S. Army supplying much needed information concerning the people encountered within the continent of Africa. He was an authority on non-self-governing territories. Bunche came to the State Department where he had held several offices, including that of associate chief of the Division of Dependent Area Affairs. He was the first negro to hold an important "desk job" in the State Department. He was the director of United Nations Trusteeship Division and a University professor. In the former position he served with the U. N. special committee on Palestine, which investigated, in the summer of 1947 the Holy Arab-Jewish problem and recommended partition in its majority report. In 1948 he was named acting mediator of the commission to succeed the late Count Folke Bernadotte. Mr. Bunche is a born administrator and highly respected government head. Throughout his career he has used his tremendous knowledge and skills of government to promote better relations between the U. S. and rest of the world. It takes a highly trained man to sit down at the conference table and iron out difficulties which could lead to war. In this spot, one must have all the qualities of a diplomat plus the uncanny ability to know and understand the other man's exact feelings on the subject. It is in this capacity that Mr. Bunche has served with such an outstanding record.

Ralph Bunche had no doubt great obstacles to overcome on his way to fame. He has made a name for himself in government as Fermi has in atomic physics or Hemingway in literature. He is a striking example of American opportunity put to good use. America is certainly proud of Mr. Bunche. In his own circle, he has a wife and three children. He spends most of his time with them and watching Jackie Robinson play ball.

Last year, Mr. Bunche was on our campus delivering the keynote speech of the human relations conference sponsored by the Hillel Foundation and coordinately organized by Mirian Sheldon, Dean of Women. He is probably the one man who knows more about human relations than anyone else. We salute citizen of the world, Ralph Bunche.

DIAMOND NEEDLE BOOM

Diamond phonograph needle sales have jumped more than tenfold in the last six years. In addition, about 70,000 diamond needles are sold each year for use in disk and belt-type office dictating machines. An estimated 40,000 needles per year are sold for original equipment and replacements in juke boxes.

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Selecting Your Employer

by R. H. Earle

The engineering student who is about to graduate and start on his working career often is confronted by so many job openings that he has difficulty in selecting the best one. Obviously, he wants to choose the position which offers him the best opportunity to develop his talents to the utmost, contribute the most to the organization he selects, and receive in return the greatest compensation in the form of recognition, personal enjoyment in his work, and his salary.

The young engineer's problem bears a striking similarity to that of a man who has some money to invest on a long-term basis and wishes to purchase common stock in the business concern which will give him the greatest return over the long pull.

Investment counsellors have some guides that they follow in advising prospective investors. The counsellors point out, as good investment possibilities, companies that are in a growing and an essential industry, have financial stability, and are operated by a seasoned management. It is interesting to see if these same guides could not be followed by the young engineer selecting a job.

One of the first things the young engineer and the investor have to decide is to what degree they wish to speculate because there is no such thing in the business world as absolute security, either for the money invested in a business or for the men that make up the organization.

The investor who is young, healthy, and financially independent, even during emergencies, can afford to take greater risks with his common stock fund than could, for example, an older man with family responsibilities, limited resources, and few years to recover from any financial losses he might experience. Likewise, the young engineer who is healthy and financially independent can afford to take a greater risk in the selection of a job than a young man who is married, has a family, and is solely dependent upon his monthly salary.

I believe that most young engineers and most long term investors in common stocks can take a so-called "businessman's risk," because they are both looking for a moderate amount of security. Engineers and investors seek an opportunity for progress through growth of the company with which they are associated.

At this point it might be interesting to trace the history of a typical company or typical industry in our economic system today.

The usual pattern is for the early stages of an industry to be quite hazardous from a financial standpoint and very speculative for both the investors and the employees. For example, the very earliest railroads that were built shortly after the steam locomotive was invented were very hazardous ventures and, undoubtedly, much money and many jobs were lost in the early stages.

Very often in these early stages there is not a market yet for the product being sold. Further there has not been engineering design data accumulated to the point that a thoroughly satisfactory product can be designed and produced. The result is likely to be frequent customers' complaints and consequent losses from replacing defective products. As the industry and the companies in it gain more experience, establish a market for the product, and accumulate know-how and facilities, a reasonable measure of stability gradually evolves. The industry then enters a so-called "growth" period. If the product or service has a wide appeal, the market develops rapidly, and for some years shows no sign of saturation. During this period the industry and the companies in it are likely to grow at a more rapid rate than business in general.

Gradually as enough companies get into the business to supply the market adequately, the market approaches a ceiling and is ultimately made up of two parts: first in the replacement of products that have already been sold and have been worn out in service; second in supplying new buyers who have never owned the product before. This latter part of the market is pretty well geared to the increase in population. As conditions change and new products gradually supersede the existing product, the market levels off and then begins to decline. The classic example is the buggy whip business which was undoubtedly thriving 100 years ago but has now practically disappeared because of the automobile superseding the horse and buggy.

The foregoing history is quite typical of most industries and the companies that form it.

Sometimes as an industry starts to decline, alert manufacturers recognize trends away from their original field of endeavor and branch out into new fields, but many do not and ultimately become casualties in the business world. This, of course, results in loss to the holders of common stocks and the employees who have made up the organization. This typical industry pattern having a speculative start, then a period of growth, the reaching of the zenith, and ultimate decline, is recognized by investment counsellors and could well be kept in mind by the young engineer selecting his first job.

In general, not very many investors nor very many young engineers can afford to take the chances of the extremely young industries and companies. It is true that our great companies of today were at one time extremely small, and those investors and employees who stayed with them have made fabulous profits or have advanced into high positions through the growth of the company.

The risk of such situations is well illustrated by the dozens of automobile companies which were formed and went bankrupt in the early days of that industry. Out of those early troubled times have grown the great automobile companies of today, some of which rank among our most stable enterprises. Manufacturing automobiles is no longer a particularly speculative line of business; investments and jobs with these companies compare favorably in security with our other leading lines of business.

If a person has the emotional make-up to be happy in very speculative situations, he can consider joining an organization in the very early speculative stage. However, he should be sure that he really has this make-up and can be happy and retain his health under prolonged conditions of extreme uncertainty. A man who is somewhat more conservative, but does not demand a maximum of security, can well consider one of the smaller companies in a growing well-establishing industry.

The company should have a successful record which means the management should have proven itself over a period of years not only to be able to manage well, but also to be progressive, and the company should be in good financial shape. It should have a history of more than average growth which frequently means that in its own industry, its line of products does not completely cover the field. Therefore, the company can grow not only as its industry grows, but also as it adds new products progressively to round out its line. These smaller companies are apt to grow faster percentage-wise than their very large competitors who have been in business so long that their line of products is virtually complete. These large companies are likely to offer a little more security, particularly in the early years of employment, but probably not quite the opportunities for advancement for the average young engineer.

The man who needs still more security to remain happy and whose inclinations are perhaps not very competitive, will probably be better satisfied in one of the largest companies in the most stable industries whose products or services find a market both in good times and bad. As a general rule, these very secure positions do not pay as much salary as the more speculative ones, but there are frequently other forms of compensation such as more favorable insurance, pension or medical treatment plans, company activities, and, above all, peace of mind of the employee.

Now suppose that the young engineer or investor has sized up the situation and has boiled his choice down to a few companies which appear to offer about equal prospects in the future, there is not much more that can be done. The final choice becomes largely a matter of chance and is relatively unimportant as far as the odds are concerned.

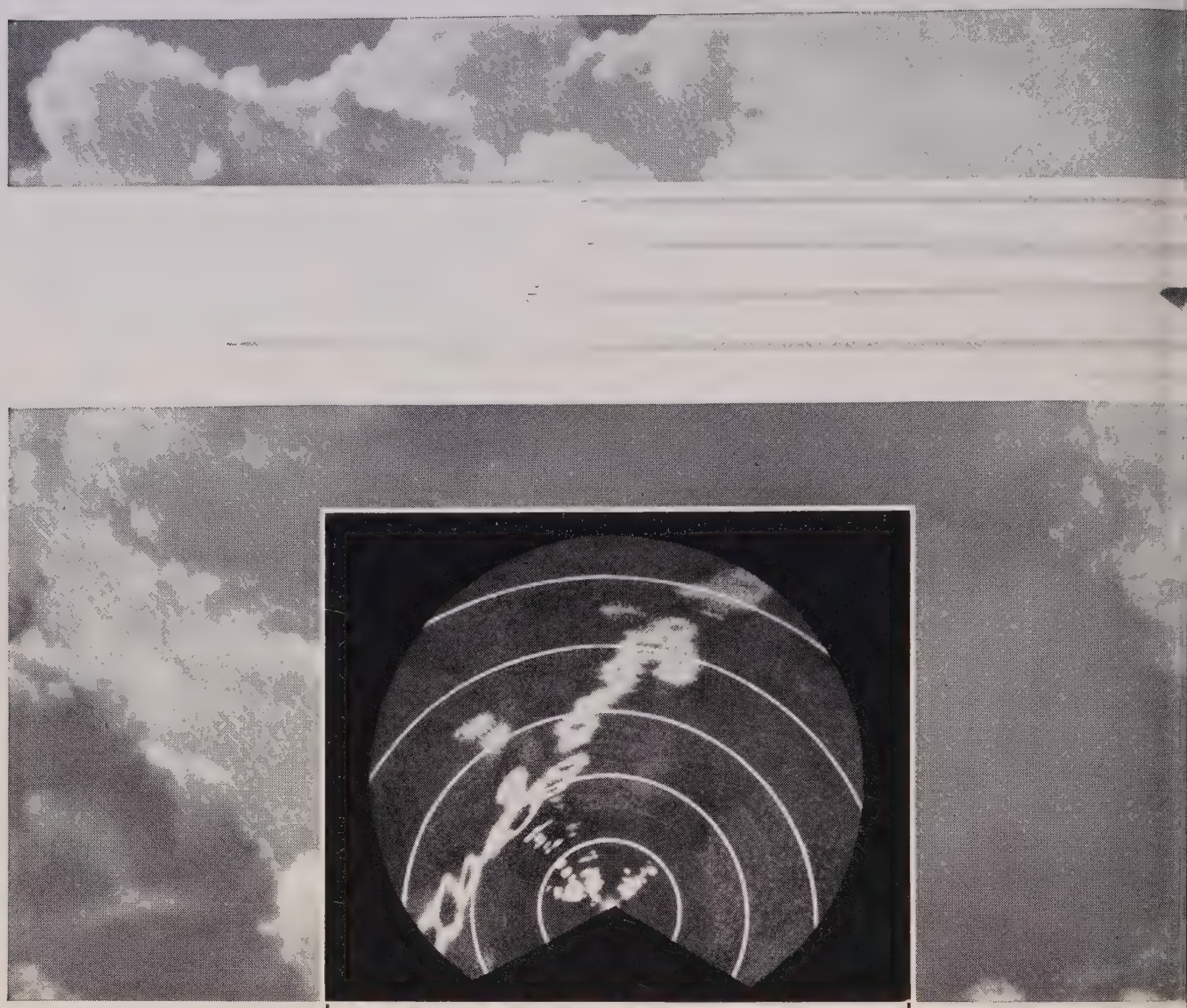
It appears, therefore, that the guides of the investment counsellor in choosing attractive common stocks for his client can be useful to the young engineering graduate confronted with a great many opportunities for employment. Both the investor and the young engineer are likely to do well with a growing company in a growing industry, and both will find it impossible to predict much ahead of time their exact rate of progress with extreme accuracy. Both the young engineer and the investor who are willing to take a reasonable amount of risk will find the odds in their favor if they choose an aggressive growing company in a growing industry that is well established in our economic pattern.

UNIFORMS ARE POPULAR

Truck drivers like to wear uniforms, a publication reports as the result of a survey of 618 operators who control 98,022 vehicles. Becoming an important item in fleet operation, uniforms are now worn by drivers of nearly half the fleets surveyed. Providing uniforms as a bonus or award for meritorious service is a growing practice. Main conclusion is drivers like, in this way, to be identified wth their employers, with a substantial number paying some part of the uniform cost. Gray is the favorite color, with green as runner-up.

TO DE-SALT THE SEA?

A pilot plant for de-salting sugar juices through ion exchange membranes with the aid of electric current will be installed on Maui, Hawaiian Island. As applied here, the de-mineralizing involves partial removal of salts such as potassium chloride, thus enabling increased recovery of sugar. The technique further is seen as a possible means of de-salting sea water.



Actual storm ahead as pilot sees it on radar scope. It indicates that, by changing course very slightly, he will find a smooth, safe route.

Bendix AIRBORNE RADAR

Bendix* Airborne Radar, a device carried right in the airplane to spot storms miles ahead, has been used by the military for several years. Now Bendix is supplying it to airline and company-owned aircraft.

This new device does what human eyes cannot do. It not only sees up to 150 miles ahead, even in the blackest night, but also looks right through storms and shows their size and intensity.

In the small photo above, for example, you can see white areas which are a line of storms. Those with black centers represent great turbulence. With only a slight change in course the pilot avoided these storms.

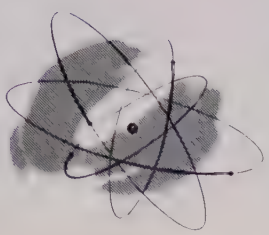
Airlines are buying Bendix Airborne Radar bec it makes possible a more comfortable, swifter ride more direct course. Without airborne radar it has been necessary to fly many extra miles to avoid st whose areas and intensities were not definitely kn

Pilots hail it as one of aviation's most impor developments, not only because of its storm-war accuracy, but because it also acts as a navigational Even in heavy overcasts it can see rivers, mount and the outline of the terrain below. Write Bendix R Division in Baltimore for further information.

This is one of the hundreds of products Bendix

12 of the basic industries in which Bendix products play a vital role

ELECTRONICS

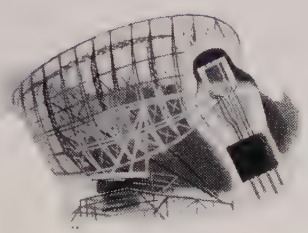


ATOMIC ENERGY

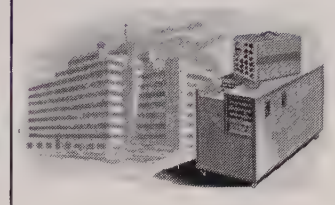
AUTOMOTIVE

AVIATION

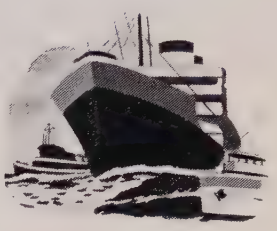
GUIDED MISSILES



RADAR

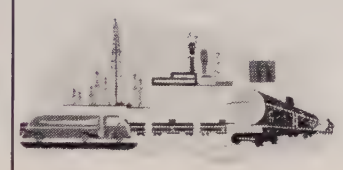


COMPUTERS



MARINE

RAILROAD



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Fluoridation . . .

HELPFUL or HARMFUL

by Philip Voegtle, San. E. '55

Some fifty years ago in a small Colorado town, a new idea was born which grew to be a major public health problem and which is now in the process of being tossed back and forth between the pros and the cons. To the pros it isn't so much a problem as it is a solution to a problem; and to the cons it is felt detrimental, not only to their own health, but to the health of the public confronted with this new idea. The exchange or arguments between the pros and cons brought about a great deal of research on the subject.

In 1906 Frederick S. McKay, a practicing dentist in Colorado Springs, Colorado, found brown and yellow stains in the enamel of human teeth. He believed these stains were due to the presence of some unknown chemical in the water supply.

This was verified some years later in 1929 when the fluoride ion was accused of being the caustic agent responsible for the mottled enamel.

In the year immediately following, through the work of two men, H. T. Dean and E. Elvove, who were associated with the National Institute of Dental Research, the non injurious amount of fluoride in a domestic water supply was determined to be one part per million, (1 p.p.m.).

With the publication of this fact, people living in areas where the fluoride ion concentration in their water supply was in excess of 1p.p.m. became greatly concerned. Public Health authorities were aroused because there were 631 communities in thirty-eight states which included some one million five-hundred thousand people that were served by water supplies containing naturally occuring fluoride ion in concentrations greater than 1.5 p.p.m.

Research was begun immediately on the problem of removing excessive amounts of fluoride ion from domestic water supplies, but nothing developed except a few makeshift ideas, which were colored by local conditions.

In 1938 a new view on the presence of the fluoride ion in a public water supply was presented by H. T. Dean. His studies revealed that a low concentration of fluoride in a water supply was beneficial in the prevention of tooth decay. He also revealed that the optimal effect was obtained in the range of 1.0 to 1.5 p.p.m.

This was the proverbial spark that set off the explosion dividing the public into the pros and the cons.

After years of preparation, large research projects were set up in such cities as Grand Rapids, Michigan; Newburgh, New York; Sheboygan, Wisconsin; Evanston, Illinois. The water supplies in these cities were treated with a fluoride compound, such as sodium fluoride, while a town nearby where fluoridation was not practiced was used as a control. Some of these cities began to report reductions in tooth decay a few years after fluoridation was begun. Reports stated the success of fluoridation in the experimental cities listed.

Today there are about twenty million people in the United States, and two hundred thousand in Canada that are served fluoridated water. The wide spread usage, however, is no indication that fluoridation is safe and beneficial. Only careful experimentation can prove this. Health authorities have much to say about the results obtained from various experimental cities.

Before 1938 it was conclusively proven that high concentrations of fluorides in a domestic water supply about 2 p.p.m. would cause mottled enamel of the teeth of the users of this water.

In 1938, H. T. Dean demonstrated that there was an inverse ratio between fluoride ion concentration and dental caries. He stated that optimal effect was obtained in the range 1.0 to 1.5 p.p.m. He based this on extensive studies made in twenty-one cities in four states. They were Illinois, Indiana, Ohio, and Colorado. The studies were on 7257 children between the ages of twelve to fourteen. These studies were made on influential variabls such as, environment, diet, public water supply constituents, etc. The final results revealed that the only factors that showed remarkable correlation were the dental caries' rates and fluoride ion concentration.

The prevalence of dental caries was reduced fifty to sixty-five per cent in 1953. Literature published by dental and public health associations is over stocked with further proof of the effectiveness of fluorides in reducing dental decay. There are about eight major research programs in progress today in the United States and Canada which have been active for as many as two to eight years, which have been proving again and again that children who use fluoride-free water have two or more times as many dental caries as children drinking fluoridated water.

The following are some statistics from the eight major research programs.

Brantford, Ontario, Canada: The permanent teeth of six-year-old children felt a reduction in dental decay of fifty-six per cent.

Evanston, Illinois: The number of twelve to fourteen-year-olds whose teeth were unsusceptible to decay increased to seventy-three per cent.

Grand Rapids, Michigan: Six-year-old children presented a sixty-six per cent

A Campus-to-Career Case History

Jim O'Hara (left) works out a problem with a member of his crew

His territory:

TWO CITY BLOCKS

James O'Hara, Stevens Institute of Technology (M.E. '51), is an installation foreman for the New York Telephone Company. His present assignment is two city blocks between 45th and 47th Streets in the middle of Manhattan.

• • •

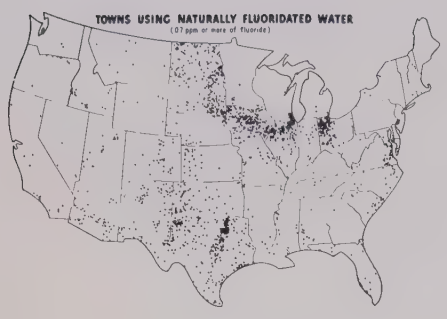
"It doesn't measure very big horizontally," Jim says. "But vertically it makes up a lot of telephone business—7500 telephones to be exact. My eight-man crew does everything from installing a single telephone to working on complete dial intercom systems for some of the nation's biggest businesses.

"I've got to know about each of these jobs that my men do. My training with the telephone company took me through the installation, repair and testing of the various types of telephone equipment and service for which I am responsible. I even had a chance to do a little experimenting of my own and developed a new way of preventing oil seepage on automatic switching equipment. I understand it's being written up for use throughout the Bell System.

"That's what I like about telephone work. Even two city blocks are full of opportunity."

You'll find that most other college men with the telephone company are just as enthusiastic about their jobs. If you'd be interested in a similar opportunity with a Bell System telephone company—or with Sandia Corporation, Western Electric or Bell Telephone Laboratories, see your Placement Officer for full details.

BELL TELEPHONE SYSTEM



reduction in dental decay, and nine-year-old children smiled with a thirty-nine per cent reduction.

Lewistown, Idaho: Six-year-old children again but this time they boasted of a seventy-seven per cent reduction in decay rate in comparison with a forty-seven per cent reduction for their nine-yar-old class mates.

Madison, Wisconsin: The primary teeth of the kindergarten class saw a forty-eight per cent reduction in dental rot.

Marshall, Texas: The six-year-old group appears again, but not too happy. Why? They only have a forty-seven per cent reduction in tooth decay.

Newburgh, New York: Worn out but still leading the pack the six-year-olds, carrying a seventy-eight per cent tooth decay reduction. The twelve-year-olds aren't doing badly either with a twenty-six per cent dental decay reduction.

Sheboygan, Wisconsin: The twelve to fourteen-year-olds are happy with a reduction in dental decay of thirty per cent.

While Dean's studies were made on cities having varying amounts of naturally occuring fluoride in the water supply, the eight cities previously mentioned were artificially fluoridated. The hypothesis was that water treated with fluoride would produce the same effects on dental decay as water naturally containing fluoride.

Under the direction of specialized technical personnel and with the supervision of the State Department of Health, annual dental and medical studies were made on the children in the eight experimental cities. By chemical and biological research, by laboratory experimentation, and by epidemiological studies, the hypothesis was proven valid.

According to recent studies, the protection from tooth decay with the use of fluorides in the water supply decreases with the increase of age. This means that at the age of twenty or older, people do not benefit from drinking fluoridated water. The reason for the diminishing rate of dental protection is that people have not been in contact with fluoridated water soon enough. Authorities say that in order to get maximum reduction in tooth decay, people must start drinking fluoridated water at a very early age. The older the people, the less is the reduction of tooth decay.

The effects of fluoridation on the teeth of people between the ages of twenty to forty-four who have been in contact with a naturally occuring fluoride bearing water supply throughout their lifetime is demonstrated by the studies made on the people living in Colorado Springs, Colorado. Clinical dental examinations were given to the people who have been exposed to Colorado Springs' water supply, which contains about 2.5 p.p.m. of fluorides, for a long period of time. These examinations were also given to the people in the same age group living in a nearby town, Boulder, Colorado. The people from Boulder were used as a control because the fluoride ion is nonexistant in Boulder's water supply. The prevalence of fluorosis was constant throughout all age groups in Colorado Springs because of the high concentration of fluorides in their water supply, while the people in Boulder exhibited no evidence of the disease. On the other hand Boulder had sixty per cent higher decayed, missing and filled teeth (D.M.F.) than Colorado Springs for each age group.

Fluoridation of water supplies, just as pasteurization of milk, innoculation against smallpox, and chlorination of water supplies, has been met with organized opposition, although it is probably the most important development in the history of preventive dentistry.

Innoculation against smallpox caused such an uprisal that people who were innoculated were considered a public menace. Innoculations were made secretly. A hospital was burned for fear that it might be turned into an innoculation center. Fluoridation has not met with violence, as has innoculation against smallpox; but it has met with the poison pen. It has been the victim of "name calling" in all the media of communication.

There are many accusations against fluoridation. One of the first was probably that fluoridation was a cause or an accelerator of cancer. This statement probably originated from the article in the Texas Dental Journal of September, 1951. It concerned a mouse cancer experiment which was conducted at the University of Texas. Almost all the mice died of cancer. However, they did not die because of the 0.44 p.p.m. fluorides that they were fed. They died because they were a special strain which was highly susceptible to mammory tumors.

Another interesting fact is that in a few towns in Texas where the fluoride concentration exceeds 3.0 p.p.m., the mortality rate of cancer is eighty-one per hundred-thousand. However, in California where the concentration of fluoride in a water supply is little or none, the mortality rate is one hundred-forty-nine per hundred-thousand.

These Towns Add Fluoride

Another accusation against fluoridation is that it causes unsightly staining of the teeth. This is true but only when the fluorides are in a high concentration, (2 p.p.m. or more). This also depends upon the individual differences. At the concentration recommended by health authorities which is 1 p.p.m. mild cases of dental fluorosis still occur in less than ten per cent of the children using this water. These mild cases of fluorosis can be detected only by the trained eye. A major portion of them will be found only on the back teeth. Many dentists believe that the amount of mottling associated with 1 p.p.m. fluorine in drinking water in most parts of the United States actually enhances the beauty of the teeth.

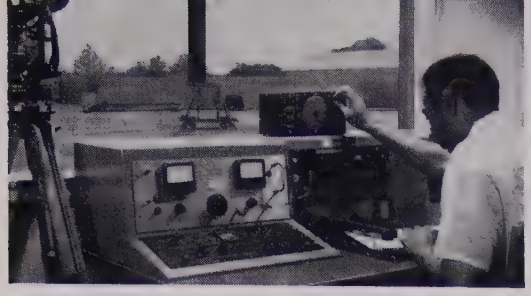
Fluoridated water cannot be accused of being poisonous just because fluorides are used in rat poisons. There are many minerals which we consume today that are deadly at high concentrations. Sodium chloride, ordinary table salt, is just one example of them.

Fluorides in water do not cause bones to become brittle. Detailed studies on 1,458 high school boys in seven cities with varying concentrations of fluorides in the public water supplies showed no effect on bone fracture experience. Where water contains from 1.2 to 3 p.p.m fluorine, x-ray examinations of persons living in the area revealed no evidence of bone fluorosis.

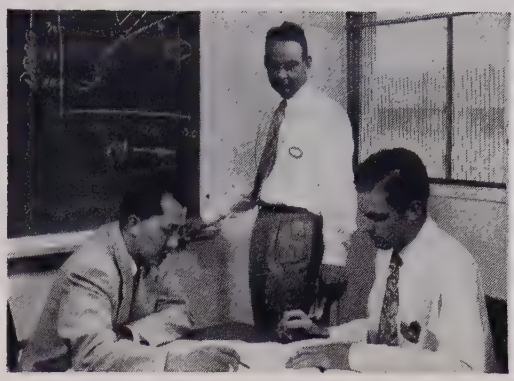
The assertion that inorganic fluorides inhibit essential enzyme functions in humans is a half truth frequently employed by opponents of fluoridation. The critical consideration of this assertion is the fact that the amount or concentration of fluoride is not specified. With a high concentration of fluorides, enzyme functions may be inhibited. There has, however, been no evidence that fluoride ions at a concentration of 1 p.p.m. in water will adversely affect any enzyme of the body.

The State of Illinois, Department of Public Health made studies on the death rates in twenty-two cities in Illinois. They concluded the following:

"Mortality statistics show that there is no significant difference in the general death rates between areas where fluor-



Electronics Research Engineer Irving Aine records radiation antenna patterns on Lockheed's Radar Range. Twenty-two foot plastic tower in background minimizes ground reflections, approximates free space. Pattern integrator, high gain amplifier, square root amplifier and logarithmic amplifier shown in picture are of Lockheed design.



Jim Hong, Aerodynamics Division head, discusses results of high speed wind tunnel research on drag of straight and delta wing plan forms with Richard Heppe, Aerodynamics Department head (standing), and Aerodynamicist Ronald Richmond (seated right). In addition to its own tunnel, Lockheed is one of the principal shareholders in the Southern California Cooperative Wind Tunnel. It is now being modified for operation at supersonic Mach numbers.

Research Engineer Russell Lowe measures dynamic strain applied by Lockheed's 500,000 lb. Force Fatigue Machine on test specimen of integrally-stiffened Super Constellation skin. The Fatigue Machine gives Structures Department engineers a significant advantage in simulating effect of flight loads on a structure. Among other Lockheed structures facilities are the only shimmy tower in private industry and largest drop test tower in the nation.

C. H. Fish, design engineer assigned to Lockheed's Icing Research Tunnel, measures impingement limits of ice on C-130 wing section. The tunnel has a temperature range of −40°F. to +150°F. and maximum speed of more than 270 mph. It is the only icing research tunnel in private industry.

Advanced facilities speed Lockheed engineering progress

Lockheed's unmatched research and production facilities help make possible *diversified* activities in virtually all phases of aviation, military and commercial.

They enable engineers to test advanced ideas which would remain only a conversation topic in firms lacking Lockheed's facilities. They help give designers full rein to their imagination. They make better planes — and better careers.

Engineering students interested in more information on Lockheed's advanced facilities are invited to write E. W. Des Lauriers, Lockheed Student Information Service, Burbank, California.

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BURBANK **California**

ide is present and those where it is absent. Similarly there is no significant difference in the risk of death from specific diseases such as heart, cancer, nephritis, and diabetes."

Through the research done on the effects of fluorides on yeast fermentation, the Pabst laboratories reported that the concentrations of fluorides up to 5 p.p.m. had little or no effect on yeast fermentation. The concentration of fluorides reached 6,000 p.p.m. before its killing power on yeast cells was comparable to that of a one per cent solution of phenol.

Pabst brewers weren't the only ones to report that fluoridation didn't affect their industry. Nine breweries in Wisconsin alone reported no effects found on the fermentation process when fluoridated water was used.

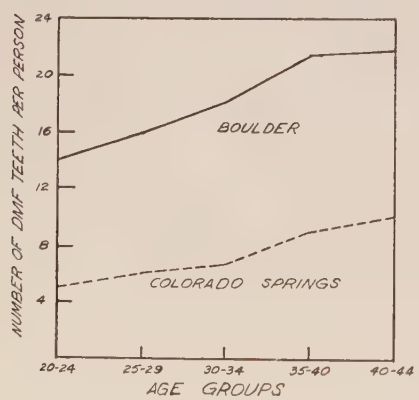
From the laboratories of the American Institute of Baking echoed the same results. This time, however, no effects were obtained until the concentration of fluorides reached 10 p.p.m.

The American Bottlers of Carbonated Beverages concluded that no effects resulted from using fluoridated water from the fact that several companies were operating in cities where fluoridation was practiced with no ill effects.

The canners primary concern was the effects of fluoridated water on flavor, color, or texture of their product and the corrosive effect on the can. There were no reports of ill effects on the food process. Therefore, it is safe to assume that there were none.

The only industrial complaint of fluoridated water came from Charlotte, North Carolina, where an ice manufacturing plant reported a fifty per cent increase in the cracking of ice blocks when 1.0 p.p.m. fluoride was added to the water supply. This was remedied by adding twenty p.p.m. of ammonium chloride to the water at the ice plant. No other such happening has been reported, and it is believed that the excessive cracking was due to the low alkalinity of the water supply.

An interesting effect was that of fluoridated water on plants. Studies were made in 1953 at the University of Illinois fluoricultural greenhouses on seven



different types of flowers—Calhopsis, Chrysanthemum, Cynoglossum, Marigold, Marvel of Peru, Nicotina, and Zinnia. They were watered for two months with fluoridated water varying in concentration from 0.0 to 100.0 p.p.m. Up to 50 p.p.m. the difference in the weight of the flowers was not significantly changed, but in height the Marigolds when water with 1 p.p.m. and 5 p.p.m. were about 1.3 inches taller than those watered with tap water, which were used as a control.

Fluoridation is not mass medication. Medication in the pure sense of the word means to cure or treat an existing disease or condition. Fluoridation does not cure tooth decay; it prevents it. Fluorides are natural consitutients of water, as they are in teeth and bones. Fluorides are added to increase their concentration in the water to a more beneficial range. The addition of fluorides to the water is like enriching bread with vitamins to make the bread more healthful. It is like adding table salt or other materials to food to make it more healthful and palatable. Certainly the enrichment of bread with vitamins and the addition of table salt to food are not considered mass medfication. Why then should the enrichment of water with fluorides be considered thus?

Fluoridation does not constitute socialized medicine. Fluoridation is not medication or any form of medicine. Fluoridation is no different from chlorination or any other measures used to prevent disease. Fluoridation is a preventive measure not a cure.

Fluoridation is not a restriction of religious freedom. This is based on the assumption that fluoridation is medicated water. Even if it were, the First Amendment to the Constitution of the United States states that the right of a special group to engage in the practice of its religion must not unreasonably interfere with the right of a community as a whole to enjoy what it determines is beneficial for its well being.

1,000 p.p.m. sodium fluoride is necessary to cause acute diseases. The amount of sodium fluoride necessary to produce this degree of concentration would be eight thousand pounds per one million gallons. According to the program set up by public health authorities, such an amount of fluoride ion could not enter the water system unless gross negligence occured. As for sabotage occuring, why should a saboteur depend on tons of sodium fluoride to do the job when only one ounce of other poisons, as botulinus toxin, in a reservoir would perform a more complete job.

Fluoridation will not present many difficult engineering problems. The mechanics of fluoridation are no more involved than those of water purification. The machinery and equipment commonly used in water plants are easily adapted. On the whole fluoridation is practical from an engineering standpoint.

Climate is an important factor which must be considered in fluoridating a public water supply. When the mean annual temperature is approximately 50°F., the fluoride ion concentration greater than 1.6 p.p.m. will produce objectionable fluorosis. Whereas, when the mean annual temperature is approximately 70°F., the fluoride ion concentration greater than 0.8 p.p.m. will be sufficient to produce the same results. This is probably because people living in warmer areas tend to drink more water and, consequently, consume a greater quantity of fluoride ions.

Temperature is not the only climatic factor to be considered. However, studies made indicate that relative humidity and mean annual temperature combined provide adequate indexes for determining the fluoride ion concentration to be added. For a more complete study of the optimal amount to be added, the evaporation point, which depends upon wind movement and barometric pressure, should also be taken into account.

Fluoridation is said to be a preventative of tooth decay; but what is tooth decay and when did it originate? Tooth decay probably originated with Adam and Eve in the beginning of mankind. Of course, there are no records of this medical development; but there are records of tooth decay occuring thirty-seven centuries before Christ.

After fifty years of research supported with recent studies, the American Dental Association gives this definition of tooth decay:

> "Dental caries are caused by acids resulting from the action of micro-organisms on carbohydrates, are characterized by a decalcification of the inorganic portion and are accompanied or followed by a disintegration of the organic substance of the tooth."

The micro-organism which produces the acid that causes tooth decay is *Lactobacillus acidophilus.* Therefore, to reduce tooth decay we must either reduce the production of this acid or decrease the solubility of the tooth enamel in the acid. The fluoride ion accomplishes both.

During the experiments on Newburgh, New York, counts were made on the number of bacteria per cubic centimeter in the saliva of children. Using two criterion, a negative count (under 100 bacteria per c.c.) and a high count (over 20,000 bacteria per c.c.), samples were taken prior to fluoridation and then annually afterwards. At the end of one year the negative count went from 11.9% to 13.4%, and the high count dropped from 63.5% to 55.2%. After two years the negative count was twenty per cent and the high count was forty-seven per cent.

A quantitative analysis made on sound

adjustable with respect to the guide so that proper centering can e obtained. The guide and die are so located that there is an an-ular space between them through which the rubber compound aches the conductor.

The driven screw of the extruder forces the unvulcanized com-ound through the guide and die assembly around the conductor. he equipment is provided with a driven take-up capstan which ills the conductor through the machine and a revolving pan in hich the rubber-covered conductor is laid. Successive layers of the overed conductor are separated with finely divided talc to prevent dhesion of successive layers during vulcanization. A tape may be pplied over the insulation on larger conductors before vulcaniza-on to assist in maintaining concentricity of the insulation with e conductor.

Rubber or rubber-like jackets are applied to rubber insulated ngle conductor cables or over the assembly of multiple conductor sulated cables by the extrusion process. Such jacketed cables are

Continuous Cure Process

ken up in pans of talc as described for insulated conductors. A ntinuous lead sheath is applied over the unvulcanized jacket com-ound and the lead covered cable taken up on reels for vulcanization.

ULCANIZATION—The pans or reels containing the unvulcanized bber insulated conductor or jacketed cable are then placed in a lcanizing chamber where they are subjected to steam at the re-ired pressure and for the required time to suitably vulcanize the bber. The pressure is then slowly reduced to atmospheric pressure nd the pans or reels removed from the vulcanizer and allowed to ol. The insulated conductors are then removed from the pans. his handling of the insulated conductor in pans through the extru-on and vulcanizing processes accounts for the term "pan cure rocess". Non-permanent tapes are then removed from strip insu-ted conductors and the lead tube from the jacketed cables.

ONTINUOUS CURE PROCESS—The continuous cure process employs standard extrusion machine similar to that used in the pan cure rocess, but equipped with a modified head to which a vulcanizing be is attached and provided with means for automatically control-ng the temperature of the cylinder, screw and head.

The head differs from that used in the pan cure process in that e guide and die are mechanically centered with respect to each other nd the compound space surrounding them is smaller. Centering of e guide and die is obtained by the use of accurately machined olders which fit snugly into perfectly centered openings in the head. This provides centering of the insulation or jacket compound at all times without adjustment by the operator. The compound space in the head is reduced to prevent premature vulcanizing of the highly accelerated compounds used in this process. Automatic control of the temperature of the cylinder, screw and head is required for successful extrusion of such compounds.

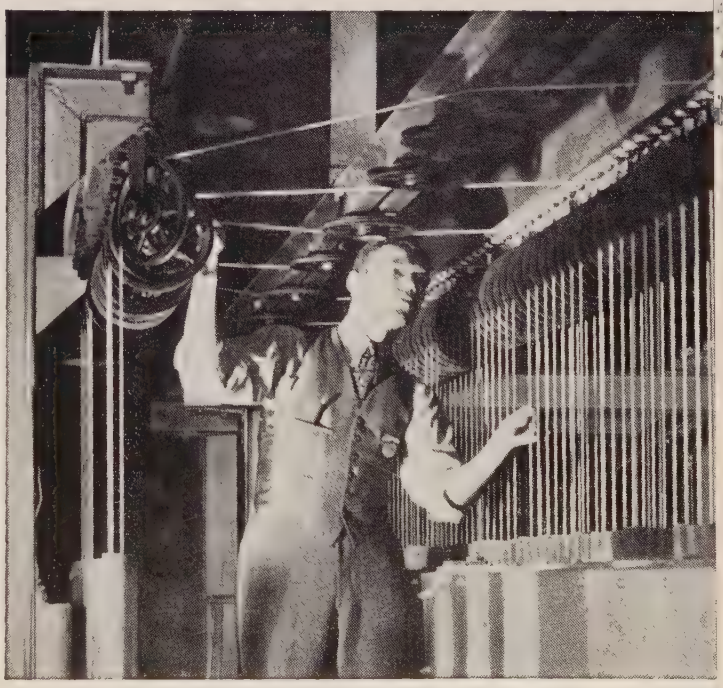
The vulcanizer attached to the tubing machine consists of a 2-inch steel pipe jacketed with a properly insulated 3-inch pipe and is approximately 125 feet in length. Vulcanizing steam pressure is maintained in the annular space between the vulcanizing tube and jacket to insure immediate attainment of the vulcanizing temperature when steam is admitted to the vulcanizer tube. The vulcanizer is provided with a splice box adjacent to the tubing machine and a suitable seal at the opposite end.

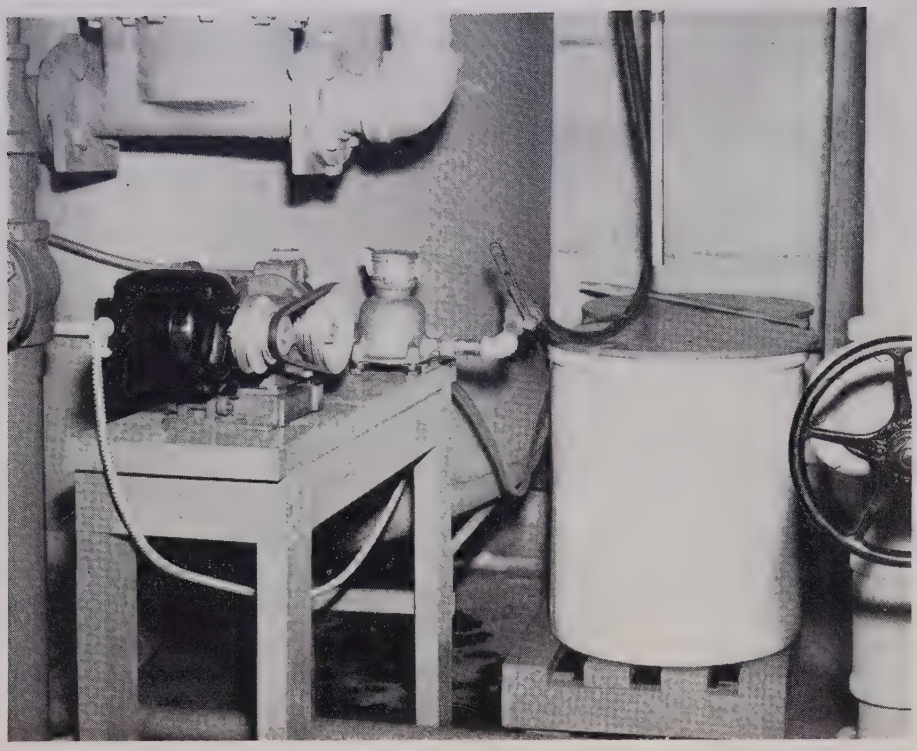
The driven screw of the extruder forces the unvulcanized compound through the guide and die assembly around the conductor or cable and directly into vulcanizer containing steam at 225 pound pressure. Highly accelerated compounds capable of vulcanizing in a few seconds are used so that the process can be operated at economical speeds. The speed of travel of a covered conductor or cable and the acceleration of the compound are so adjusted that the insulation or jacket is properly vulcanized while traveling the length of the vulcanizer. The vulcanized insulated conductor or jacketed cable is taken up on a suitable reel directly from the vulcanizer. The term "Continuous cure process" follows from the fact that the insulation or jacket is applied and vulcanized in one operation.

APPLICATION OF LATEX—The application of latex insulation consists of passing the coated conductor beneath the surface of a latex compound from which it is brought vertically into a suitable drying chamber. It continues to travel vertically in the chamber until the film is dry. It is then returned for the application of a second layer of compound. This alternate dipping and drying is continued until a wall of the required thickness is applied and dried. The amount of insulation deposited per application depends on the conductor size, the viscosity and temperature of the latex compound and the speed to which the conductor travels.

The conductor, covered with the required thickness of dried unvulcanized latex compound then passes through a vulcanizing chamber where the insulation is vulcanized and continues through a talc applicator to the take-up reel. This process is thus a continuous one in that the application of the insulation to the conductor and its vulcanization are accomplished in one operation.

Application of Latex





Equipment necessary to fluoridate a public water supply using a liquid feeder system, proportioners included. (Photo by State Department of Public Health)

teeth and carious teeth from the same mouth by Armstrong and Brekhus showed that the sound teeth contained 110 p.p.m. of fluorine while carious teeth contained only 69 p.p.m. of fluorine. As the other constituents remained approximately equal, it was proven, indirectly, that fluorine decreases the solubility of teeth.

Even this conclusive evidence reveals that the fluoride ion is still not the ideal inhibitor. Concentrations too toxic are necessary to inhibit the production of all destructive acids. However, if the amount of acids is reduced ten per cent, this will still ensure a reduction in decay rates of from sixty to ninety per cent.

The cost of fluoridation varies depending upon the amount and type of fluoride used. It averages yearly about nine cents per person. The cost of an average filling will provide a person with enough fluoride ion for thirty years. Fluoridation will reduce future dental bills for extractions, fillings and other dental work. More than nine hundred communities in the United States have demonstrated that fluoridation is inexpensive.

Fluoridation has been endorsed by important national associations as the American Dental Association, the American Water Works Association, the American Public Health Association, the American Medical Association, and the American Association of Public Health Dentists.

The history of fluoridation began as early as 1906 when Frederick S. McKay, a practicing dentist in Colorado Springs, Colorado, accused a caustic agent in the drinking water, later found to be the fluoride ion, for the mottled teeth of his patients. Later men like H. T. Dean and E. Elvove did research on the fluoride ion and found that 1.0 to 1.5 p.p.m. fluorides was beneficial in the reduction of tooth decay, but that a great concentration of the fluorides was responsible for the staining of teeth. Much research is and was done on fluoridation.

Many claims were made against fluoridation. It was claimed poisonous, too expensive, the cause of disease, and detrimental to industry. Research has proven each claim wrong in its turn. Research has proven that fluorides added to the water improve the appearance of teeth and reduce dental decay in children about forty-five per cent. It has proven that fluoride does not change the physical character of water—taste, color, odor, or hardness; that fluorides do not produce ill effects in industrial plants; and that the yearly cost of fluoridating water per person is only 9c per year.

On the basis of the evidence revealed in the preceding material, it is safe to conclude that fluoridation is beneficial and should be practiced universally, except, of course, in places where the fluoride ion is already in sufficient amount. Truly to delay the fluoridation of public water means to deprive children of the proper health benefits. This is especially true since these benefits can be obtained at very little cost.

Miss March

Our Technocutie this month is Anne Barretta, a twenty-year old miss from Meadville, Pennsylvania. Here on campus she is employed as a stenographer in the Electrical Engineering Building. Anne's hobby is art and at present time she is taking an art course at the University. For those of you whose hobby is collecting statistics, the following information might be up your line. Anne is 5'2" tall, weighs 123 pounds, and tapes 34-24-34. She has brown eyes and brown hair, and for those who are interested she isn't attached. By the way, she mentioned that she is overrun with work at the EE Building and would appreciate any help volunteered.

DAVID L. KOMYATHY
Photographer

She: What's the difference between dancing and marching?

He: I don't know."

She: I didn't think you did. Let's sit down.

* * *

Pledge (at dinner table): "Must I eat this egg?"

Brother: "Yer darn right!"

Silence.

Pledge: "The beak, too?"

* * *

Lawyer: "What if a man IS on his hands and knees in the middle of the road? That doesn't prove he's drunk."

Policeman: "No, it doesn't. But this one was trying to roll up the white line."

* * *

Hudson House Supervisor—How do you like this room as a whole?

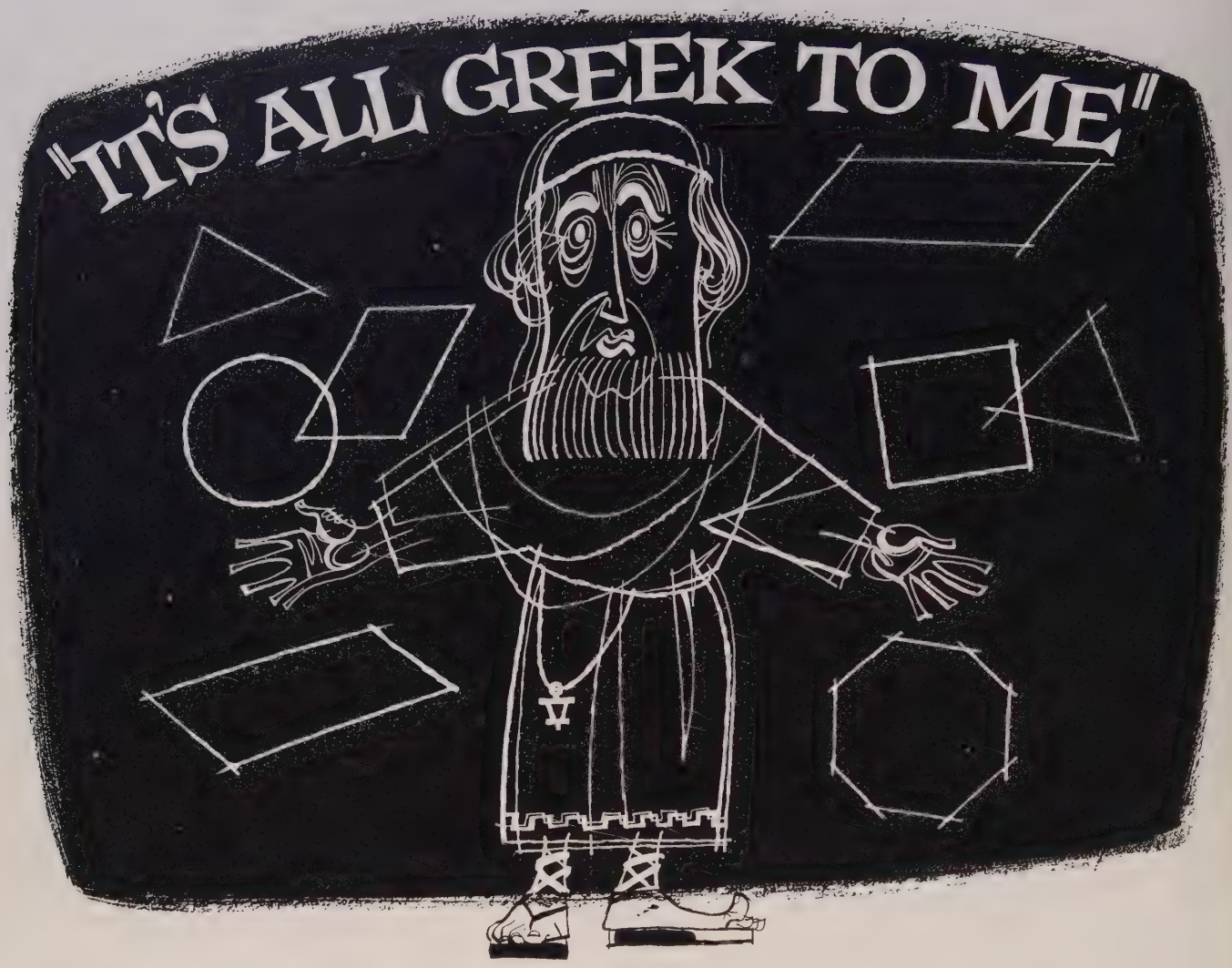
Incoming Student—As a hole, it's fine; as a room, not so good."

* * *

Once a young college female wrote the editor of a correspondence column, "I am only 19 and I stayed out till two the other night. My mother objects. Did I do wrong?"

The answer published in the paper the next day: "Try to remember."

Techno-cutie of the month . . .



LUCKILY, EUCLID WAS A GREEK

From the drawing boards at New Departure have come many of the world's ball bearing advancements. Such leadership is one reason why engineers everywhere specify New Departure ball bearings.

If Euclid had lived 2,300 years longer, he would have made Tau Bete. That's why he's pictured here wearing the Tau Beta Pi key.

After all, every engineer owes Euclid a big debt. At New Departure, for example, we work with circles and spheres. Without Euclid, we might still be getting started.

As it is, though, New Departure has gone further with spheres and circles in relation to moving parts than anyone else in the world. From this knowledge have come such advances as the Sealed-for-Life and the double-row angular-contact ball bearings. And it's advances like these that make New Departure the world leader in ball bearings.

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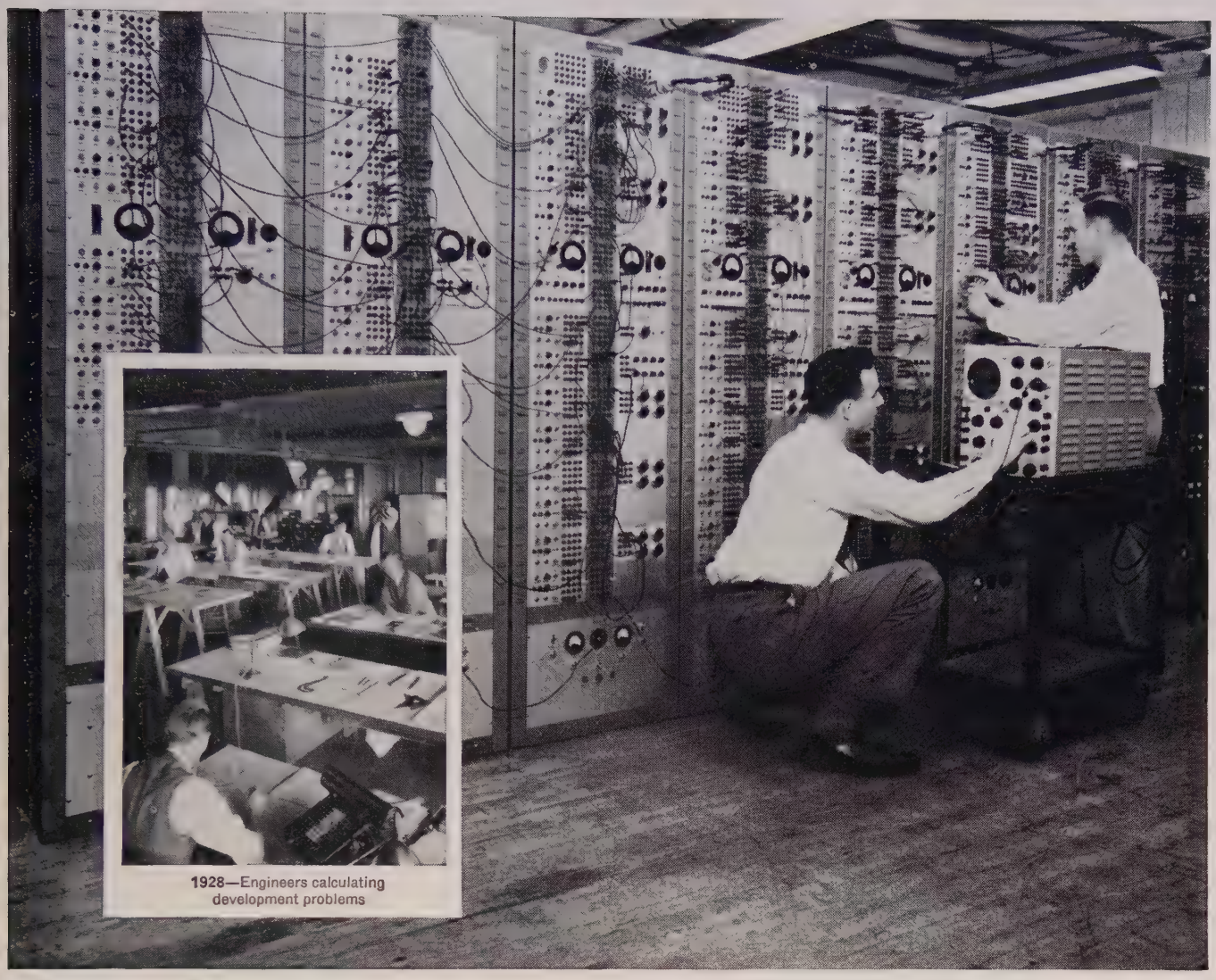


1928—Engineers calculating development problems

1955—Solving complex engineering problems with Boeing computer

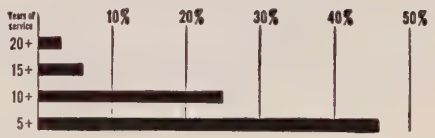
The best research facilities are behind Boeing engineers

The Boeing-designed electronic computers shown above solve in seconds problems that once required weeks—typical of the advanced "tools" that help Boeing engineers stay at the head of their field.

Boeing engineers enjoy such other advantages as the world's fastest, most versatile privately owned wind tunnel, and the new Flight Test Center—the largest installation of its kind in the country. This new Boeing Center includes the latest electronic data reduction equipment, instrumentation laboratories, and a chamber that simulates altitudes up to 100,000 feet. Structural and metallurgical research at Boeing deals with the heat and strain problems of supersonic flight. Boeing electrical and electronics laboratories are engaged in the development of automatic control systems for both manned and pilotless aircraft. Other facilities include hydraulic, mechanical, radiation, acoustics, and rocket and ramjet power laboratories.

Out of this exceptional research background engineers have developed such trend-setting aircraft as America's first jet transport, and the jet age's outstanding bombers, the B-47 and B-52. Research means growth—and career progress. Today Boeing employs more engineers than even at the peak of World War II. As the chart shows, 46% of them have been here 5 or more years; 25% for 10, and 6% for 15.

Boeing promotes from within and holds regular merit reviews to assure individual recognition. Engineers are



encouraged to take graduate studies while working and are reimbursed for all tuition expense.

There are openings at Boeing for virtually all types of engineers—electrical, civil, mechanical, aeronautical and related fields, as well as for applied physicists and mathematicians with advanced degrees.

For further Boeing career information consult your Placement Office, or write:

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Company, Seattle 14, Wash.

BOEING

SEATTLE, WASHINGTON WICHITA, KANSAS

by Donna Rudig, Jim Piechocki, and Millard Darnall

KEITH A. YARBOROUGH

One of the best-known faces down around the Boneyard these days is none other than Keith Yarborough, president of Engineering Council, Mu San, and Chi Epsilon. He is from La Grange, where he debeated on his high school team.

A staunch supporter of Engineering activities, Keith has worked on Engineering Open House each year and helped with St. Pat's Ball. As if these

KEITH A. YARBOROUGH

activities and his presiding duties are not enough, he also belongs to Phi Eta Sigma, Phi Kappa Phi, Pi Mu Epsilon, and Tau Beta Pi, plus winning a scholarship bauble last year. He firmly believes that the purpose of Engineering Open House is threefold: (1) to demonstrate to the people of this state the potential of training and research which this university offers, not only in the line of defense but also in that important project—raising the standard of living, (2) to help potential engineers become interested in the various fields of engineering and to familiarize them with the type and quality of training which can be obtained; (3) to let industrialists and producers know that our engineers are adept in the art of working with people, supplementing their technical knowledge.

Keith is also an enthusiast of traveling, especially that which includes fishing and camping. Because of his interest in historical reading he would particularly like to visit Germany, France, and England.

After graduation Keith intends to continue here at Illinois until completion of his M. S.; he is already taking some graduate courses. Eventually he would like to teach Sanitary Engineering or related courses to college students.

LARRY KIEFLING

If you ever walk into the TECHNOGRAPH office one afternoon and find someone wading through the files, you can bet your best slide rule that it's Larry Kiefling at his job of circulation manager again. This Cowden, Illinois, (pop. 600) lad not only handles circulation, but also turns out a mighty fine news article each month. And almost as a sideline, he maintains a 4.4 average to boot!

Larry made Phi Eta Sigma, the freshman honorary, in his first year at the University of Illinois, and he humbly tells us that there are other invitations to honorary fraternities resting on his desk at home.

When asked what particular aspect of engineering interests him, Larry leaves the impression that he's interested in them all. His Tech articles prove this,

LARRY KIEFLING

for he has covered subjects from diffraction gratings to Super Sabres. Then, too, if you're in the mood for a discussion about the relative merits of rural and urban living, Larry's the man to see.

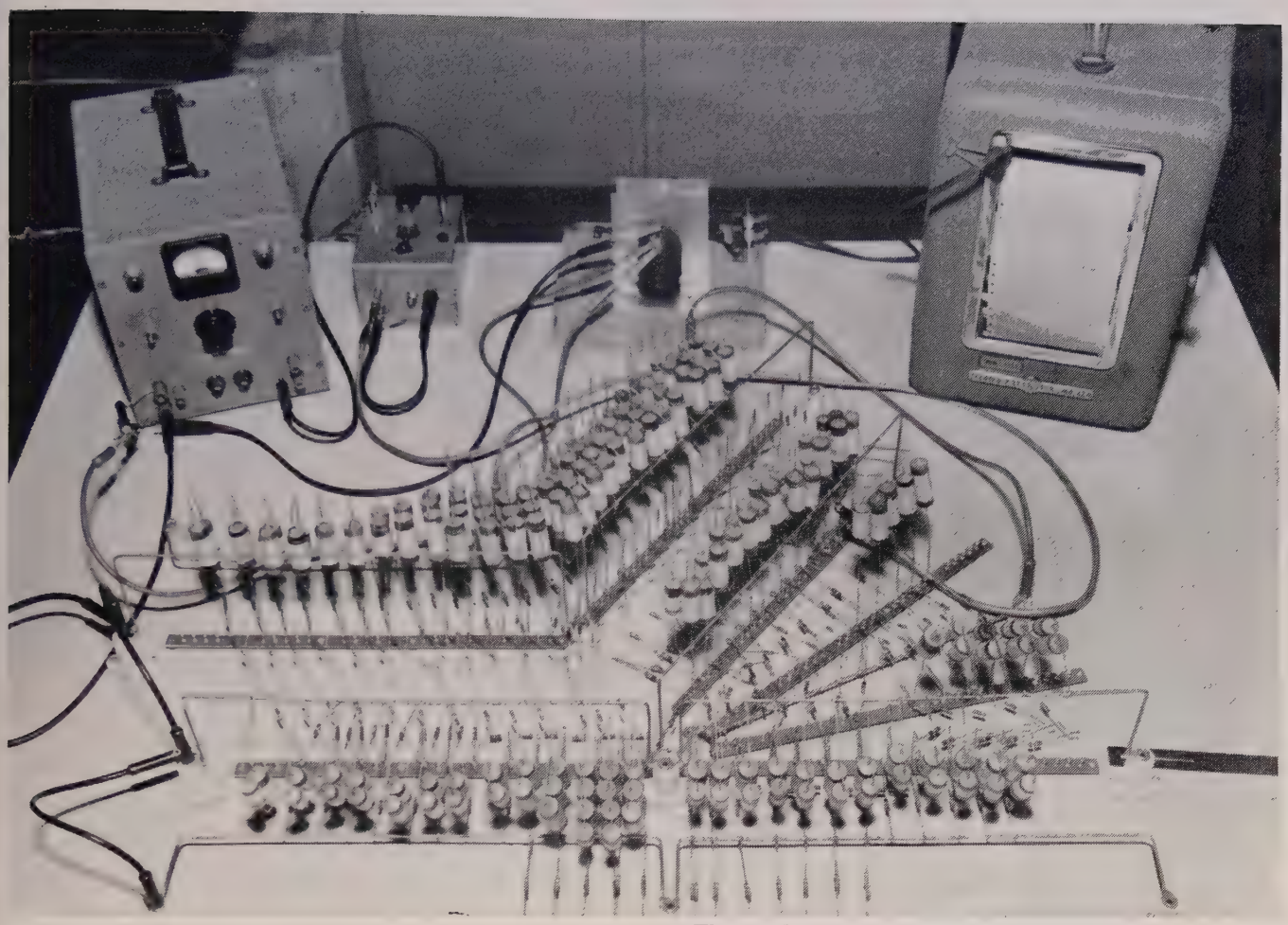
And what's the word around the Tech office when the deadline ogre rears its urgly head? Why, "Copy from Kiefling," of course.

HOWARD L. WAEELAND

Howard Wakeland graduated with a B.S. in Agricultural Engineering in 1950 and with a M.S. in the same field in 195. Howard worked on the Illinois State Water Survey for a year after he received his B.S. degree, and the past three years he has been an instructor in the Agricultural Engineering Department. Howard is now teaching half-time and working half-time in the Engineering college office as an assistant associate dean.

Mr. Wakeland's hobbies all seem to have some connection with sports. He referees high school football and basketball in the Champaign area. Baseball and golf are also his hobbies.

Mr. Wakeland remarked that he is surprised at the number of freshmen that he has already met in his officiating of high school sports. He said he has recognized many men who he had put out of a basketball game with five personal fouls. *(Continued on Page 60)*



This analogue computer, a pioneer in this age of "thinking machines", was developed by Standard Oil scientists.

New Electronic "Engineer" Solves Tough Refinery Problem

THE MEN who design modern oil refineries need specific information about temperature distributions in different parts of pressure vessels. Such information, essential to safety and efficient operation, is often extremely difficult to obtain by conventional mathematical methods.

Scientists at Standard Oil's Whiting laboratories recently developed and built an electrical analogue capable of simulating specific conditions within a refinery unit still in the design stage. Using this device, they could determine in advance the temperature distribution in the joint between two pressure vessels having a common head. Thus they were able to duplicate in 20 seconds the heat stress picture within the unit during an 8 hour start-up to shut-down period.

Creative scientific thinking made possible this constructive achievement by engineers who have chosen to build their careers at Standard Oil.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

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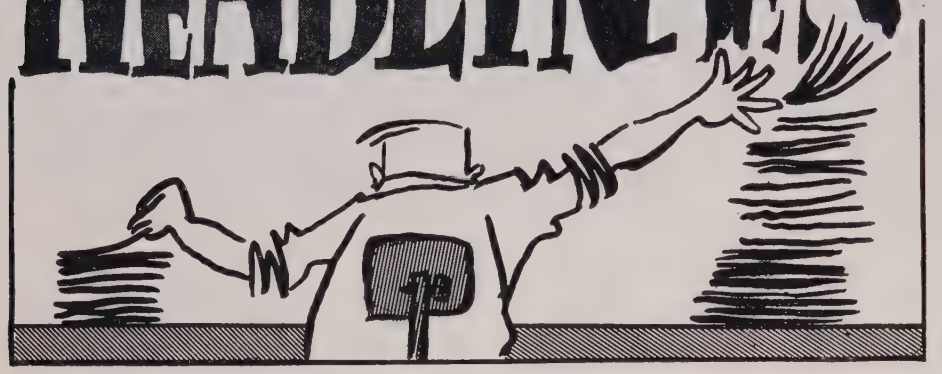


by Larry Kiefling, M. E. '56

Fighter Planes Launched

Piloted jet fighter planes are being launched like guided missiles. Using platforms mounted on trucks to explore the possibility of eliminating runways under certain combat conditions the world's first flights of conventional jet fighters without preliminary take-off runs were hailed as ushering in a new era in aerial warfare.

The launching technique was developed by the Air Research and Development Command of the Air Force and the Glenn L. Martin Company. Employing the same principles and equipment used in launching the Martin Matador and Air Force guided missiles, engineers conducted experiments at Edwards Air Force Base, California. Warweary F-84-G Thunder Jets made the historic flights. Standard production Republic Thunder Jets were modified so booster bottles could be attached beneath their tails. The boosters are the same type and size used on the Matador.

Highly mobile trucks with arms, raised the fighter planes to the launching angle and became the world's smallest airports with the plane's turbo jet engine running at full speed. The thrust of the booster bottles kicked the fighters off so swiftly they were immediately airborne. Martin test pilot Bob Turner said the shock of the unconventional take-off was less than what pilots experience during catapult take-off. The planes were always under the pilot's control and a peak acceleration of four "G's" was reached (one "G" is pull of gravity).

Because launchers are so mobile, they can be moved quickly from one place to another. No permanent installations are necessary—no runways, hangars or other construction.

The developers of the launching system envisioned jets operating close to the front line and preventing minimum targets to the enemy. Conventional landings could be made at forward bases and the aircraft immediately dispersed for maximum protection while readying for the next flight.

"This is a new concept of fighter plane dispersal," on Air Force spokesman commented. "It is especially important in the age of the atomic warfare when a single enemy plane might wipe out a single airport and make its entire area indefinitely untenable."

Zero length launching, while not a new development, has been proven by nearly 200 Matador launchings. The Thunder Jets, considerably larger than the guided missiles, have demonstrated that the technique is practical and adaptable for fighters.

Windshield Research

Safer, icre-free aircraft windshields now are being built as the result of a 4½-year research program concluded recently at Armour Research Foundation of Illinois Institute of Technology, Chicago. The project was sponsored by the Wright Air Development center, Dayton, Ohio, so designers could specify failure-proof windshields that would never shatter, but only crack under the worst military and climatic conditions.

Two of several important developments resulting from the project were released by William T. Savage, supervisor of the materials engineering section, and Joseph S. Islinger, associate research engineer, both at the Foundation:

1. A system was developed for measuring over-all optical quality of windshields as they were affected by imposed laboratory conditions. The system employes a rectifying plate that corrects for distortion directly, thus alleviating the necessity of mathematical corrective calculation after test photographs are made.

2. A windshield mounting employing a synthetic fiber cloth was developed. The fiber, replacing aluminum in some applications, improved stress isolation of the windshield, necessary in conditions of intense airframe distortion and vibration.

Most of the research was undertaken to find a pressure-proof, distortion-free, anti-icing windshield that would be satisfactory for global operation, Savage and Islinger said. One experiment sought to keep the temperature on the outer surface of the windshield at about 40 degrees F. to prevent ice from forming.

In others, scientists had to consider air friction, evaporation, thermostatic arrangements for controlling the heat, stresses, and other complex factors.

Safety also entered the picture in the case of pressurized cabins or cockpits. In order to establish design limits for concepts determined throughout the program, engineers simulated flight conditions, putting their windshields through vigorous tests. Experimental models were subjected to low temperatures, thermal shocks such as might be encountered in flying into a super-cooled cloud, stresses caused by the heat input in deicing, more stresses induced by cabin pressurization—still others due to airframe distortion, speed, or air gusts.

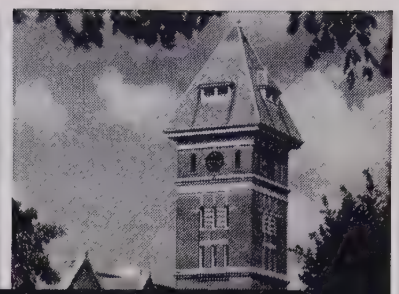
To perform many of the tests, special heat transfer and stress equipment had to be devised. Often, water was used as the heat transfer medium instead of air because it is easier to control and regulate. The stress analysis studies were similar to those used by industry to achieve stronger, lighter machine parts.

In one test, alcohol, cooled to 90 de-

WISCONSIN

MICHIGAN

IOWA STATE



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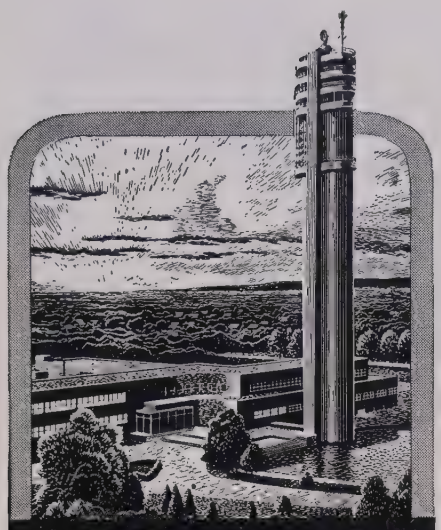

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grees below zero F., passes across one side of a pane of glass. Heat, supplied electrically, is stepped up slowly on the other side until the temperature rises to about 500 degrees F. and the glass cracks—like a milk bottle breaking when filled with boiling water.

Although windshields never may meet these extreme temperatures in use, information on temperature differences and resultant failure is valuable to designers and engineers. Benefits of the windshield research are expected to be made available to civilians early next year by the Wright Air Development center.

Overload Protector Coupling

A new overload protective coupling, whose use safeguards against costly breakdowns of machines and machinery with loss of production time and expensive material damage, is announced by the manufacturer. This device is used between any drive shaft and a

This device limits the load which can be transmitted to a shaft.

driven shaft, giving positive low cost instant protection against overloads and sudden jams.

When the torque rating of the Tork-O-Stat is exceeded, internal parts are disengaged and a complete disconnect results. When the overload or cause of jamming is removed, the unit will re-engage and normal drive is resumed automatically. Being a low cost self-contained unit, it can be close-coupled, easily installed, is small in size (only 4¼" dia. by 1 5/16" thick overall), light weight (½ pound), needs no lubrication, is tamperproof, needs no safety guard and is pleasing in appearance for external design uses.

Models are now available with torque ratings of 10, 20, 40 and 60 inch pounds, with their equivalent horsepower ratings dependent entirely upon the speeds used. Although it can be used on all machines and machinery, it is particularly essential on packaging equipment, conveyors, screw-feeds, mixers and other units vulnerable to jamming and overloading. List prices start at $7.95

Gyro Motor

A dime-sized gyroscope motor, probably the world's smallest, has been designed for application where space is really at a premium—on the moving an tenna of aircraft fire-control radar. The "inside-out" synchronous motor has a tiny wound stator; the rotor is also the inertia wheel of the gyroscope. This inside-out design, common to gyroscope motors, permits an element with a large polar moment of inertia to be built into a small space. The 2-phase, 400-cycle motor operates on less than a volt per phase, and revolves at 8000 rpm. The gyroscope measures the angular movement of the antenna, enabling computers to calculate firing information.

Ultra Flat Surfaces Help in Electron Studies

Although the multi-billion dollar electrical industry is based on the movement of electrons through metals, there are many, large gaping voids in our understanding of the mechanism of that passage. One of the problems on which research scientists are vigorously working is how conduction electrons (i.e., outer orbital electrons that can be freed to make amperes) absorb energy from impinging light, and how much. The end product of such research still in its early stages, is data for curves from which a theory can be drawn. These results, even these early ones, are of unquestioned value—but not exciting to the average engineer. However, some of the problems and the numbers dealt with in pursuing this data engender high respect for the investigators.

For example, the metal specimens must be polished to a degree that make the surface of even a high-grade telescope mirror look like an array of hills and valleys. The highest "hill" allowed on the surface is about five Angstroms high or 0.00000002 inch. A wavelength of green light is 1000 times greater.

Such super-smooth surfaces are achieved by electro-polishing. This is a relatively old technique by which individual projecting atoms are gently removed. Variations in surface can be reduced almost to the distance between individual atoms.

Giant Condenser

This giant condenser, shown under construction, serves not only its normal function but also as the foundation for the 125-mw turbine above it. It thereby saves several feet of headroom, some foundation construction, and considerable concerete. The 80,000-square-foot condenser is 60 feet long, 24-½ wide, and 14 high. With its super-structure it weighs 1,365,000 pounds. The turbine

Opportunity and Security go arm in arm at Columbia-Southern

Columbia-Southern ranks high as a company in which to make a career.

Columbia-Southern has been happy, too, with its good fortune in adding so many fine men to its organization over the past years.

Columbia-Southern has many inviting advantages. It is rich in opportunity. Columbia-Southern believes in allowing maximum flexibility and personal contact between the individual and his supervisors. The corporation wants each member to progress as rapidly as he can. Responsibilities are increased as rapidly as the individual demonstrates his ability to handle them.

Columbia-Southern has appeal in its security, too. In the nation's complex modern economy, no industry or company can expect to remain unaffected by general business conditions. Because Columbia-Southern's products have diversified applications in many essential industries, Columbia-Southern is less likely than most companies to be seriously affected by a general decline in business activity.

Columbia-Southern is a sound progressive company that abounds in opportunity. We are looking for technical graduates in many fields. If you would like to become a part of the growing Columbia-Southern organization, write Dept. P at our Pittsburgh address or any of the plants.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY

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Lake Charles, La. • Natrium, W.Va. • Jersey City, N.J.

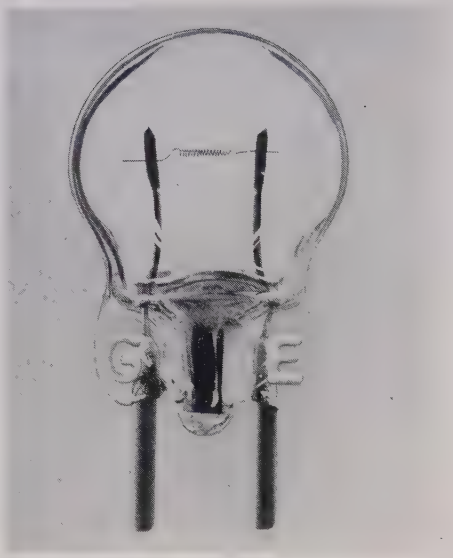
support is 80 feet long and an additional 11 feet high. It contains 5115 sixty-foot-long one-inch tubes—having a total length of nearly 60 miles. It has been installed in the Raritan River Plant of the Jersey Central Power & Light Co.

Miniature Lamp for 'Hot' Appliances

Development of a revolutionary new type of miniature lamp to be used for indicating purposes on "hot" appliances was announced today. The lamp consists of a small glass bubble sealed around a coiled filament, with two rigid pins protruding at the base.

Because it will stand temperatures nearly twice as high as conventional miniature lamps, (600°F versus 350°F) it is expected to find wide use on such appliances as waffle irons, electric casseroles, broilers, fryers, flat irons, toasters, and others where indicator lamps have been impractical or costly before. Indicator lamps are used to show whether an electrical appliance is turned off or on.

Of radically new design, the lamp differs from conventional miniature lamps in that it has no base in the ordinary sense of the word. Rather than a screw base or bayonet base, with their heat-sensitive basing cement and soldered



This tiny indicator lamp can be used at temperatures 250° higher than previous models.

connections, the new construction employs the two bare wire pins for electrical contacts. The lamp's terminals, or pins, will plug into appliance sockets in much the same manner that an electronic tube is inserted in a radio receiver. For the convenience of socket manufacturers, the pins are the same size as those on miniature electronic tubes.

Because of its resistance to heat, the new lamp can be used on appliances where lamps were impractical before, and will give manufacturers greater latitude as to location on other appliances.

Of more rugged construction than conventional miniature lamps, the new bulb will have greater resistance to shock and vibration. Another advantage of the lamp in some applications is that it will permit the exact positioning and orientation of the filament. Although the new construction is expected to be adapted eventually to a wide range of miniature lamp types and sizes, it is being made available at first in a 2.5 volt, half-ampere, 300-hour life lamp. The tiny bulb is only seven-sixteenths of an inch in diameter, and has a maximum overall length of 15-sixteenths of an inch.

Portable Geiger Counter

A portable, lightweight Geiger counter that permits field assay of radioactive substance and gives an accurate, timed count is being introduced.

The counter, called the Countmaster, weighs just 7¼ pounds, including probe

This new lightweight Geiger counter has an accurate counting range of up to 12,000 counts per minute.

and shield. An accurate counting range is claimed up to 12,000 counts per minute. The "find" is flashed upon four rows of tiny neon lights, where it remains until erased by the operator.

Introduction of the new instrument, first in a series in the field of radioactivity detection marks the first commercial product of Hoffman Labs, which heretofore has been entirely concerned with advanced research and development and production of electronic gear for the military services. More than a year of rugged environmental and type tests preceded the introduction.

The Countmaster is to be distributed through major mining supply companies and through television distributors. Price is $250.00.

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Diversity of alphabets, numerals, symbols, designs, trademarks available from stock or made to your special order, is almost unlimited with Leroy® Lettering Equipment. You can have practically anything you want. Yet, unlike freehand, the work will always be neat and uniform. Diversity of products for engineers' and draftsmen's needs is one of the keys to K&E leadership in drafting, reproduction, surveying and optical tooling equipment and materials, in slide rules and measuring tapes.

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ALLISON Engineers Break Ground for New Turbine Engine Test Facilities

E. B. NEWILL, Georgia Tech, '15, now General Manager, Allison Division and Vice President of General Motors Corporation, breaks ground on another addition to our turbine engine test facilities.*

Allison Jet engine designers soon will have even larger and improved test facilities to use in developing turbo-jet engines.

Performance requirements for future military and commercial aircraft make necessary the development of new turbo-jet engines far more complex and powerful than present types. New and specially-designed test equipment is required to accurately determine performance of the principal engine components—compressors, turbines, and combustors—before the complete engine is tested.

For instance, capacity for 75,000 horsepower is being established to pump air at the rate of 300 pounds per second. This air must be compressed and heated to 1000 degrees, or cooled to a minus 67 degrees, enabling Allison to test combustors at simulated altitudes up to 65,000 feet.

With our expanding and long-range engineering program, we need additional young engineers. Allison, a leader in the design, development and production of turbo-jet and turbo-prop engines, NOW offers young graduate engineers unusual opportunities for progress where future development is unlimited.

Write for information:

R. G. GREENWOOD, Engineering College Contact
ALLISON DIVISION, General Motors Corporation
Indianapolis 6, Indiana

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* Left to right—Dimitrius Gerdan, Chief Engineer, Turbo-Jets, U. of Michigan, 1932, BS in Mechanical Engineering and Industrial Engineering; T. W. Meeder, Chief Test Engineer, U. of Michigan, 1932, MS in Aeronautical Engineering; R. E. Settle, Assistant Director of Engineering, Purdue University and Indiana Central College, BS in Mathematics; Paul Hunt, representing Huber, Hunt & Nichols, Inc., contractor; E. B. Newill, Georgia Institute of Technology, degrees in Mechanical and Electrical Engineering; Harold H. Dice, U. of Illinois, 1929, BS Business Administration; Col. S. A. Dallas, USAF Plant Representative; R. M. Hazen, U. of North Dakota, U. of Michigan, 1922, BS in Mechanical Engineering and attended graduate school, U. of Minnesota, majoring in Metallurgy.

Technic Teasers

There was recently a sale of various articles of ladies' apparel on the second floor of a downtown department store. A young woman and her grandmother were rushing to get to the sale before the best bargains were all gone. They reached the foot of the escalator going from the first floor to the second floor at the same time and stepped on the first step together. Since they were both in a hurry to get to the sale, they did not stand still and ride the escalator up, but walked up, both at a constant rate, until they reached the top. The young lady forgot that her grandmother could not keep up with her, and walked as fast as she could. The older women was only able to take one step for every three that her younger companion took. Of course, when the young woman reached the top, she had to wait for her grandmother, so she didn't gain anything by her rushing. The granddaughter took 36 steps, her grandmother took 24 steps. How many steps were in sight at one time on the moving staircase?

A church hymn board has four grooved rows on which the numbers of four hymns chosen for the service are placed: The hymn book in use contains 700 hymns. What is the smallest number of numbler plates, each carrying one digit, which must be kept in stock so that the numbers of any four different hymns selected can be displayed; and how will the result be affected if an inverted 6 can be used for a 9?

A man is going to make a trip of 27,000 miles. His tires are guaranteed for 12,000 miles each. What is the least number of tires that he must take (including the four tires on the car) in order to make the trip? Explain.

Once upon a time, there lived a rich farmer who had 30 children, 15 by his first wife, who was dead, and 15 by his second wife. The latter woman was eager that her eldest son should inherit the property. Accordingly one day, she said to him, "Dear Husband, you are getting too old. We ought to settle who shall be heir. Let us arrange our 30 children in a circle, and counting from one of them, remove every tenth child until there remains but one, who shall succeed to your estate."

Quite astonished was the old man, as the first fourteen children eliminated were by his first wife. Noticing this he realized that the odds were 15 to 1 that the latter wife's children would be chosen. "From this point on" the man suggested that they count backward from the lone remaining child from deceased wife. Which became heir? What order did they start?

There are four kegs, all having small leaks. One fills a mug in hours; another fills the same mug in 3 hours; another in 4 hours; and the remaining keg fills the mug in ½ hour. If the liquid being lost from each keg is all funneled into the same mug, how long will it take to fill the mug?

The Problem of the Three Philosophers

Worried about their disputations and oppressed by the summer heat, three Grek philosophers lay down to take a little nap under a tree at the Academy. As they slept, a practical joker smeared their faces with black paint. Presently they all woke up at once and began to laugh at each other. Suddenly, one of them stopped laughing, for he realized that his own face was painted. What was his reasoning?

I have no watch, but I have an excellent clock, which I occasionally forget to wind. Once when this happened I went to the house of a friend, passed the evening in listening to the radio concert program, and went back and set my clock. How could I do this without knowing beforehand the length of the trip?

I had 12 bottles of rare old booze in my cellar (aged over-night) and my wife told me to empty them down the sink, or else; this is what happened:

I pulled the cork from the first bottle and poured the contents down the sink, with the exception of one glass which I drank.

I extracted the cork from the second bottle and did likewise, with the exception of one glass which I drank.

I then withdrew the cork from the third bottle and emptied the good old booze down the sink, except for one glass which I drank.

I pulled the cork from the fourth sink, and poured the bottle down the glass, which I drank. I pulled one bottle from the cork of the next drink and drank one sink out of it, and poured the rest down the glass.

I pulled the sink out of the nex glass, and poured the cork down th bottle.

I pulled the next cork out of m throat and poured the sink down th bottle and drank the glass.

Then I corked the sink with the glass bottled the drink and drank the pour.

When I had everything emptied, steadied the house with one hand, count ed the bottles and corks which added u to twenty-nine.

To be sure, I counted them again a they came by, and this time I had 74.

And as the house came by, I count ed them the third time, and finally had all the houses, bottles, corks, an glasses, except one house and one bottl which I drank.

It wall all my wife's fault.

* * *

Solve the division problems below b finding the correct digits to replace eac of the letters.

```
      EFM
   ---------
AQG/FXNQG
     XJM
   ---------
     GXQ
     QAE
   ---------
     AEJG
     ASGG
   ---------
      AQS
```

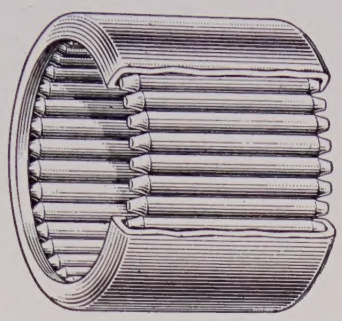
(Solutions on Page 64)

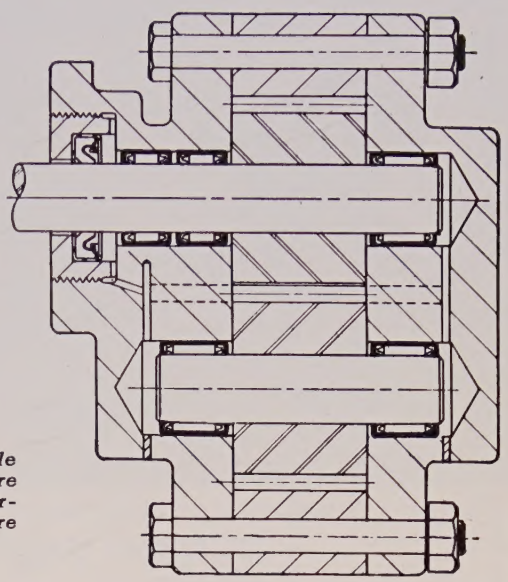
THANKS VERY MUCH, BUT I THINK I CAN MANAGE!

The Torrington Needle Bearing

proper housing design is essential to proper performance

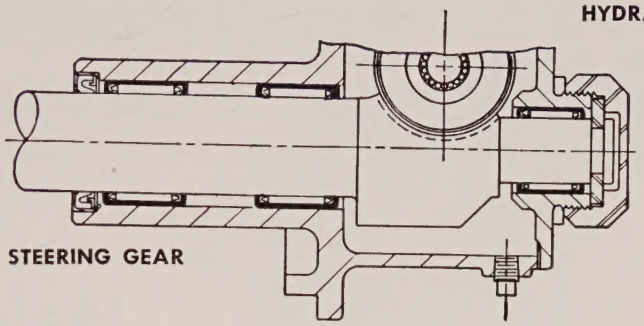
The Torrington Needle Bearing offers many design and operational advantages for a great variety of products and equipment. For example, a Needle Bearing has greater rated radial load capacity in relation to its outside diameter than any other type of anti-friction bearing. It is extremely light in weight. And it is easy to install and lubricate.





HYDRAULIC PUMP

Needle Bearings require simple housings. If the housing bores are held to proper size, accurate operation and high radial capacity are assured.



STEERING GEAR

Housing Maintains Bearing Roundness

The housing is an essential part of the Needle Bearing assembly. Care should be taken to provide a straight, round housing bore to the recommended tolerances.

The thin, surface-hardened outer shell of the Needle Bearing acts as the outer race surface as well as a retainer for the rolls. This shell assumes the shape of the housing into which it is pressed. Consequently, the housing bore should be round, and the housing so designed that it will carry the radial load imposed on the bearing without distortion.

Housing Material Determines Bore Size

The specified housing bore dimensions for any given material should be maintained in order to give the proper running clearance between the needle rollers and the shaft, and to assure sufficient press fit to locate the bearing firmly.

When designing housings of materials that are soft or of low tensile strength, allowance should be made for the plastic flow of the material when the bearing is pressed into place. Bore dimensions in such cases should be less than standard. Needle Bearings can be pressed directly into phenolic or rubber compounds, although metal inserts are recommended.

The new Needle Bearing catalog will be sent on request.

THE TORRINGTON COMPANY

Torrington, Conn. • South Bend 21, Ind.

District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON NEEDLE BEARINGS

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • STRAIGHT ROLLER • BALL • NEEDLE ROLLERS

Howard L. Wakeland is an assistant dean in the College of Engineering

(Continued from Page 48)

Besides his teaching, working in the dean's office, and officiating, Mr. Wakeland is very active in the High School Relations Committee which hold Career Days at high schools during the year. After having a very pleasant interview with Mr. Wakeland I can see where he would be very adept for such a committee.

Mr. Wakeland is a member of the American Society of Agricultural Engineers and American Society of Engineering Education. He was advisor to the student branch of the ASAE, and at the present he is an advisor to the Engineering Council.

Besides these organizations he started an Agricultural Engineering Department "Stag Party" several years ago, and this party has been a success each year. The main purpose of the party is for the students and faculty to meet each other in an atmosphere other than the classroom.

STOP-EATER

To tell the rotund eater when to stop, Control Engineering suggests a preset strain-gage circuit, mounted neatly underneath the shirt, to register abdominal tautness and start a warning buzzer in the pocket.

ECONOMICAL HINTS

A prominent display of tool and equipment costs, in the form of "price tags" hung or painted on walls or equipment, is contributing significantly to reductions in breakage of machines and tools in several plants. In one Michigan plant, tool breakage has been cut by 20 per cent and there has been substantially less machine downtime.

Believe It or Not: Adam and Eve invented the loose-leaf system.

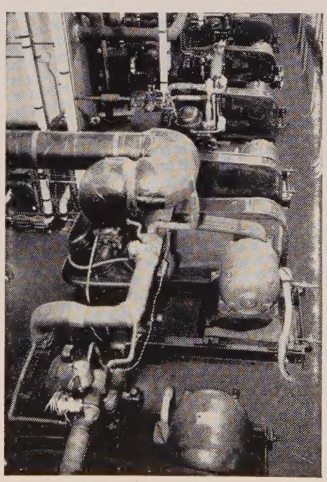
Sperry Gyroscope Co. Operates 12 Test Boxes with

FRICK Refrigeration

At the Great Neck, Long Island, plant of Sperry Co., a dozen environmental test chambers have been equipped with cooling and humidity control, operated by an elaborate low-temperature refrigerating system. This was designed and installed by Tenney Engineering, Inc., Union, N. J., using 14 Frick "ECLIPSE" compressors. Temperatures range from 100° below zero to 200° above.

Whatever your special cooling needs, there's a Frick air conditioning or refrigerating system to meet them with dependability. Let us submit an estimate: write, wire or phone—

Below: Six of the fourteen Frick "ECLIPSE" compressors installed in Sperry Engineering Test Department.



For a position with a future inquire about the Frick Graduate Training Course in Refrigeration and Air Conditioning. Operated over 30 years, it offers a career in a growing industry.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

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- **WRITING**
- **MAKE-UP**
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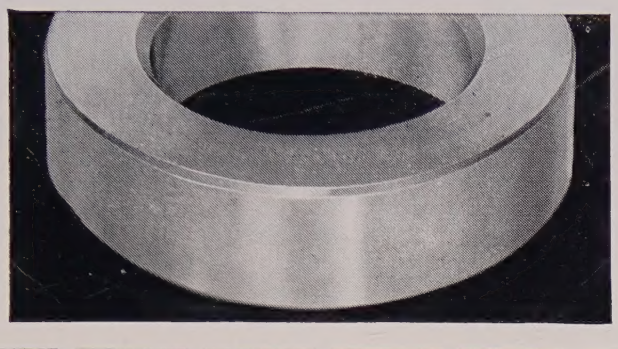
Apply at:

THE TECHNOGRAPH OFFICE

213 Civil Engineering Hall

Another page for **YOUR STEEL NOTEBOOK**

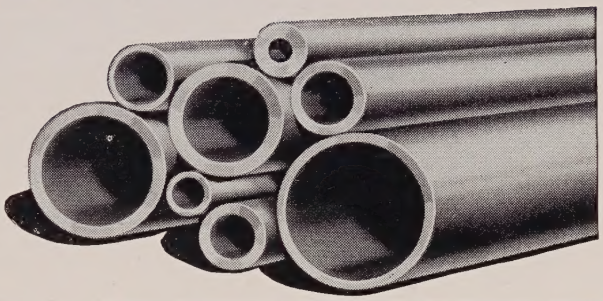
How to make a boring job go faster



With teeth cut into it, this gear blank becomes an engine part. One manufacturer thought these blanks were costing him too much to make. The center hole had to be bored out of solid bar stock. It took one hour to make 29 blanks. A lot of steel was wasted in the process. He took his problem to Timken Company metallurgists. After study, they recommended a change in production methods together with the use of Timken® seamless steel tubing.

How TIMKEN® seamless tubing helped quadruple production

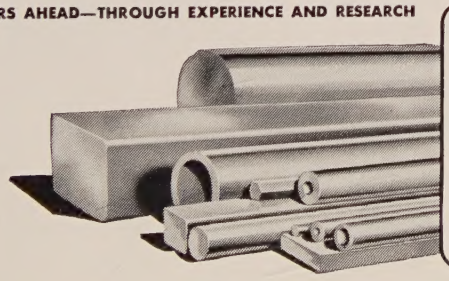
Because the hole's already there in Timken seamless tubing, it doesn't have to be bored out. *No* steel is wasted. Finish boring is now the manufacturer's first step. He can turn out 120 to 130 gear blanks per hour with a 50% cut in machining costs. This is another one of the hundreds of problems that have been solved by Timken fine alloy steel.



Want to learn more about steel or job opportunities?

Some of the engineering problems you'll face after graduation will involve steel applications. For help in learning more about steel, write for your free copy of "The Story of Timken Alloy Steel Quality". And for more information about the excellent job opportunities at the Timken Company, send for a copy of "This Is Timken". Address: The Timken Roller Bearing Company, Canton 6, Ohio.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



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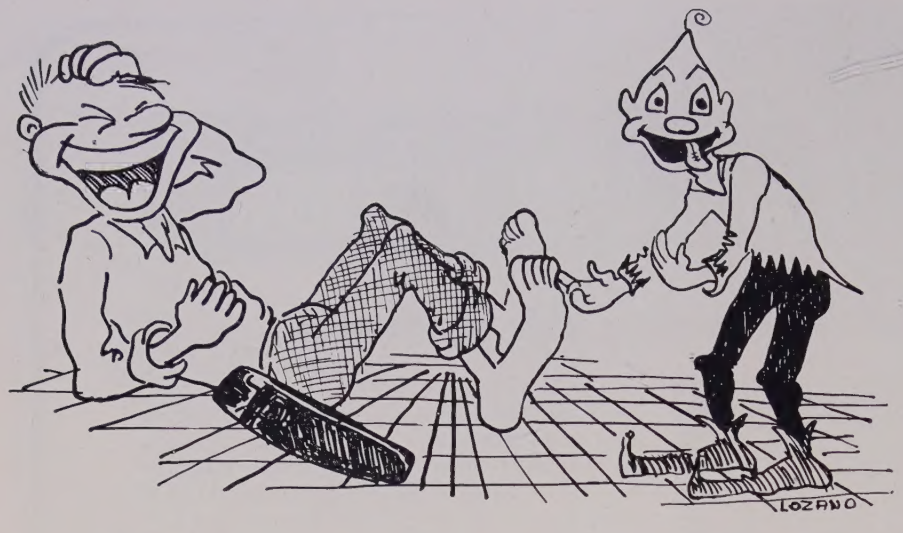
TRADE-MARK REG. U.S. PAT. OFF.
Fine Alloy
STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



TECHNOCRACKS

Solutions for Technic-teasers Found on Page 58

By logic and trial and error you will find the correct substitutions of digits for letters to be as follows:

```
  246
-----
178/43928
  356
-----
  837
  712
-----
 1258
 1088
-----
  170
```

* * *

Clock problem:

Before leaving my house, I started the clock, without bothering to set it, and I noted the exact moment A of my departure according to its reading. At my friend's house I noted the exact times, *h* and *k*, of my arrival and departure by his clock. On returning I noted the time B of my arrival according to my clock. The length of my absence was B-A. Of that time *k-h* minutes were spent with my friend, so that the time spent in traveling, *t*, in each direction, was $2t \pm (B\text{-}A) - (k\text{-}h)$. Thus the correct time when I got home was $k + t$.

* * *

Tire problem:

By alternating one tire every 3,000 miles the trip will require nine tires, all of which will have their full life used up.

* * *

Keg problem:

Let m equal mug's capacity; t equal time. Then the rates of flow from each keg are m/2, m/3, m/4, and 2m respectively. The total plus m/4 plus 2m equals 37m/12. Then 37mt/12 equals m. It follows that t equals 12/37 hour.

* * *

The Three Philosophers:

A, B, and C are the three philosophers. A thought: "Since B laughs he thinks his face is clean. Since he believes that, if he saw my face was clean also, he would be astonished at C's laughter, for C would have nothing to laugh at. Since B is not astonished he must think that C is laughing at me. Hence my face is black."

* * *

Inheritance problem:

The second wife's eldest son inherited the property. They started in any order as long as the second wife's eldest son is 29th man from original starting position.

* * *

Hymn problem:

The smallest number of plates which must be kept in stock is 86; if an inverted 6 can be used for an 9, 81 are needed.

* * *

Escalator problem:

There are 48 steps in sight at one time on the moving staircase.

It's tough to find
For love or money
A joke that's clean
And also funny.

* * *

Prof.: "When the room settles down I'll begin my lecture."

Student: "Why don't you go home and sleep it off?"

* * *

Two mosquitoes were resting on Robinson Crusoe's arm. "I'm leaving now," said one. "I'll meet you on Friday."

ROTC Student: "I haven't pencil or paper for the examination."

Sergeant: "What would you think of a soldier who went into battle without his gun or ammunition?"

ROTC Student: "I'd think he was an officer."

* * *

A farmer brought some produce to town and sold it. He thought, "I will surprise my wife." He bought a suit of clothes, a hat, a pair of shoes, and put them under the seat of his buggy. On the way home, he stopped at the river, where he took off his old clothes and threw them in. Then he looked under the seat, and found his new clothes gone. Shrugging his shoulders, he got into the buggy and said, "Git up Maud, we'll surprise her anyway."

* * *

Confucius say, "Modern woman putting up such a false front, man never knows what he is up against."

* * *

A window washer related this experience to his friends: "One day I was cleaning a window when a young woman entered and started to undress. She took off her shoes and stockings and then her dress when suddenly the ladder broke."

"What a calamity at a time like that," remarked one of the listeners.

"It sure was," answered the window washer, "but what could you expect with twenty guys on the ladder?"

* * *

OHM ON THE RANGE

Opus 314—*In Three Phase Time*

Oh give me an ohm
Where the impedances roam
Where the fields are not fluxing all day,
Where you'll never see
A field without phi,
And the flux is not leaking away.
Ohm, ohm on the range,
Where the flux is not charging all day;
Where never is seen
A shunt field machine
With its armature running away.

* * *

"Cheer up, old man. Why don't you drown your sorrow?"

"She's stronger than I am, and besides, it'd be murder."

* * *

A woman got into a cab and told the driver, "Quick, get me to the fraternity ward!"

"Don't you mean a maternity ward?"

"Oh yes, I guess I do. But hurry, I have to see an upturn."

"Upturn? Don't you mean intern?"

"Fraternity, maternity, uptern, intern, just step on it. I think I'm stagnent."